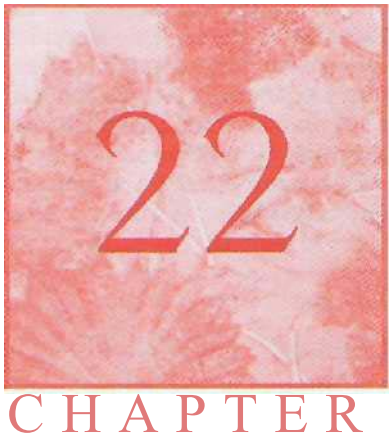
Surgical Management of Oral Pathologic Lesions

Edward Ellis III



CHAPTER OUTLINE

The specific surgical techniques for treatment of oral pathologic lesions can be as varied as those for surgical management of any other entity. Each clinician surgically treats patients using techniques based on previous training, biases, experience, personal skill, intuition, and ingenuity. The purpose of this chapter is not to describe the specifics of surgical techniques for management of individual oral pathologic lesions but to present basic principles that can be applied to a variety of techniques to satisfactorily treat patients. Discussion of this topic is made easier by the fact that many different lesions can be treated in much the same manner, as is outlined later.

BASIC SURGICAL GOALS

Eradication of Pathologic Condition

The therapeutic goal of any extirpative surgical procedure is to remove the entire lesion and leave no cells that could proliferate and cause a recurrence of the lesion. The methods used to achieve this goa! vary tremendously and depend on the nature of the pathologic condition of the lesion. Excision of an oral carcinoma necessitates an aggressive approach that must sacrifice adjacent structures in an attempt to thoroughly remove the lesion. Using this approach on a simple cyst would be a tragedy. It is therefore imperative to identify the lesion histologically with a biopsy before undertaking any major surgical extirpative procedure. Only then can the appropriate surgical procedure be chosen to eradicate the lesion with as little destruction of adjacent normal tissue as is feasible.

Functional Rehabilitation of Patient

As just noted the primary goal of surgery to remove a pathologic condition is total removal of the lesion. Although eradication of disease may be the most important goal of treatment, by itself it is frequently inadequate in the comprehensive treatment of patients. The second goal of any treatment used for eradication of disease is an allowance for the functional rehabilitation of the patient. After the primary objective of eradicating a lesion has been achieved, the most important consideration is dealing with the residual defects resulting from the extirpative surgery. These defects can range from a mild obliteration of the labial sulcus secondary to the elimination of an area of denture epulis to a defect in the alveolus after removal of a benign odontogenic tumor OT to a hemimandibulectomy defect resulting from carcinoma resection. The best results are obtained when future reconstructive procedures are considered before excision of lesions. Methods of grafting, fixation principles, soft tissue deficits, dental rehabilitation, and patient preparation must be thoroughly evaluated and adequately handled preoperatively.

SURGICAL MANAGEMENT OF CYSTS AND CYSTLIKE LESIONS OF THE JAWS

Surgical management of oral pathologic lesions can best be discussed by broadly classifying pathologic lesions into the following major categories: cysts and cystlike lesions of the jaws, benign tumors of the jaws, malignant tumors, and benign lesions of oral soft tissues.

A cyst is defined generally as an epithelium-lined sac filled with fluid or soft material. The prevalence of cysts in the jaws can be related to the abundant epithelium that proliferates in bone during the process of tooth formation and along lines where the surfaces of embryologic jaw processes fuse. Cysts of the jaws may be divided into two types: (1) those arising from odontogenic epithelium (i.e., odontogenic cysts) and (2) those from oral epithelium that is trapped between fusing processes during embryogenesis (i.e., fissural cysts). The stimulus that causes resting epithelial cells to proliferate into the surrounding connective tissue has not been determined. Inflammation seems to play a major role in those cyst arising in granulomas from infected dental pulps.

Residual fragments of cystic membrane tend to produce recurrent cysts, which necessitates complete excision of the epithelial lining of the cyst at the time operation. Some cysts (e.g., keratocysts) behave more aggressively in both destructive characteristics and recurrence rates. Cysts have been known to destroy large portions of the jaws and to push teeth into remote areas of the jaws (i.e., mandibular condyle or angle and coronoid process) (Fig. 22-1). Enlargement of cysts is caused by-gradual expansion, and most are discovered on routine dental radiographs. Cysts are usually asymptomatic unless they are secondarily infected. The overlying mucosa is normal in color and consistency, and no sensory deficits from encroachment on nerves are found.

If the cyst has not expanded or thinned the cortical _ plate, normal contour and firmness are noted. Palpation with firm pressure may indent the surface of an expanded jaw with characteristic rebound resiliency. If the cyst has eroded through the cortical plate, fluctuance may be noted on palpation.

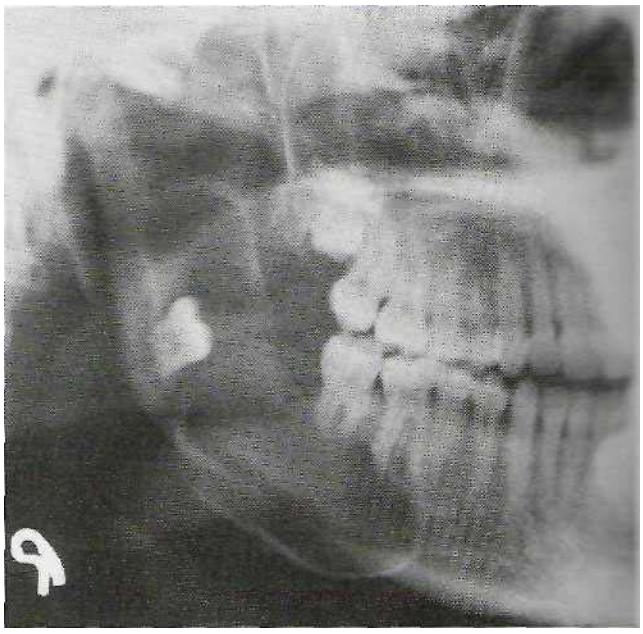


FIG. 22-1 Mandibular third molar Is displaced by cyst

The radiographic appearance of cysts is characteristic and exhibits a distinct, dense periphery of reactive bone (i.e., condensing osteitis) with a radiolucent center (Fig. 22-2). Most cysts are unilocular in nature; however, multilocularity is often seen in some keratocysts and cystic ameloblastomas (Fig. 22-3). Cysts do not usually cause resorption of the roots of teeth; therefore when resorption is seen the clinician should suspect a neoplasm. The epithelial lining of cysts on rare occasions undergoes ameloblastic or malignant changes. Therefore all excised cystic tissue must be submitted for pathologic examination.

Although cysts are broadly classified as odontogenic and fissural, this classification is not relevant to the discussion of surgical techniques to remove cysts. The surgical treatment of cysts is discussed without regard to type of cyst, except for types that warrant special consideration. The principles of surgical management of cysts are also important for managing the more benign odontogenic tumors and other oral lesions.

Cysts of the jaws are treated in one of the following four basic methods: (1) enucleation, (2) marsupialization, (3) a staged combination of the two procedures, and (4) enucleation with curettage.

Enucleation

Enucleation is the process by which the total removal of a cystic lesion is achieved. By definition, it means a *shelhng-out of the entire cystic lesion without rupture.* A cyst lends itself to the technique of enucleation because of the layer of fibrous connective tissue between the epithelial component (which lines the interior aspect of the cyst) and the bony wall of the cystic cavity. This layer allows a cleavage plane for stripping the cyst from the bony cavity and makes enucleation similar to stripping periosteum from bone.

Enucleation of cysts should be performed with care, in an attempt to remove the cyst in one piece without fragmentation, which reduces the chances of recurrence by increasing the likelihood of total removal. In practice, however, maintenance of the cystic architecture is not always possible, and rupture of the cystic contents may occur during manipulation.

Indications. Enucleation is the treatment of choice for removal of cysts of the jaws and should be used with any cyst of the jaw that can be safely removed without unduly sacrificing adjacent structures.

Advantages. The main advantage to enucleation is that pathologic examination of the entire cyst can be undertaken. Another advantage is that the initial excisional biopsy (i.e., enucleation) has also appropriately treated the lesion. The patient does not have to care for a marsupial cavity with constant irrigations. Once the mucoperiosteal access flap has healed, the patient is no longer bothered by the cystic cavity.

Disadvantages. If any of the conditions outlined under the section on indications for marsupialization exist, enucleation may be disadvantageous. For example, normal tissue may be jeopardized, fracture of the jaw could occur, devitalization of teeth could result, or associated impacted teeth that the clinician may wish to save could be removed. Thus each cyst must be addressed individually, and the clinician must weigh the pros and cons of enucleation versus marsupialization (with or without enucleation) (see discussion of Enucleation after Marsupialization).

Technique. The technique for enucleation of cysts was described in Chapter 21; however, the clinician must address special considerations. The use of antibiotics is unnecessary unless the cyst is large or the patient's health condition warrants it (see Chapters 1 and 2).

The periapical (i.e., radicular) cyst is the most common of all cystic lesions of the jaws and results from inflammation or necrosis of the dental pulp. Because it is impossible to determine whether a periapical radiolucency is a cyst or a granuloma, removal at the time of the tooth extraction is recommended. If, on the other hand, the tooth is restorable, endodontic treatment followed by periodic radiographic follow-up will allow assessment of the amount of bone fill. If none occurs or the lesion expands in size, the lesion probably represents a cyst and should be removed by periapical surgery. When extracting teeth with periapical radiolucencies, enucleation via the tooth socket can be readily accomplished using curettes when the cyst is small (Fig. 22-4). Caution is used in teeth whose apices are close to important anatomic structures, such as the inferior alveolar neurovascular bundle or the maxillary sinus, because the bone apical to the lesion may be very thin or nonexistent. With large cysts, a mucoperiosteal flap may be reflected and access to the cyst obtained through the labial plate of bone, which leaves the alveolar crest intact to ensure adequate bone height after healing.

Once access to a cyst has been achieved through the use of an osseous window, the dentist should begin to enucleate the cyst. A thin-bladed curette is a very suitable instrument for cleaving the connective tissue layer of the cystic wall from the bony cavity. The largest curette that can be accommodated by the size of the cyst and of the access should be used. The concave surface should always be kept facing the bony cavity—the edge of the convex surface performs the stripping of the cyst. Care must be exercised to avoid tearing the cyst and allowing the cystic contents to escape, because margins' of theeyst are easier to define if the cystic wall is intact. Furthermore the cyst separates more readily from the bony cavity when the intracystic pressure is maintained.

In large cysts or cysts proximal to neurovascular structures, nerves and vessels are usually found pushed to one side of the cavity by the slowly expanding cyst and should be avoided or handled as atraumatically and as little as possible. Once the cyst has been removed, the bony cavity should be inspected for remnants of tissue. Irrigating and drying the cavity with gauze will aid in visualizing the entire bony cavity. Residual tissue is removed with curettes. The bony edges of the defect should be smoothed with a file before closure.

Cysts that surround tooth roots or are in inaccessible areas of the jaws require aggressive curettage, which is necessary to remove fragments of cystic lining that could not be removed with the bulk of the cystic wall. Should obvious devitalization of teeth occur during a cystectomy,

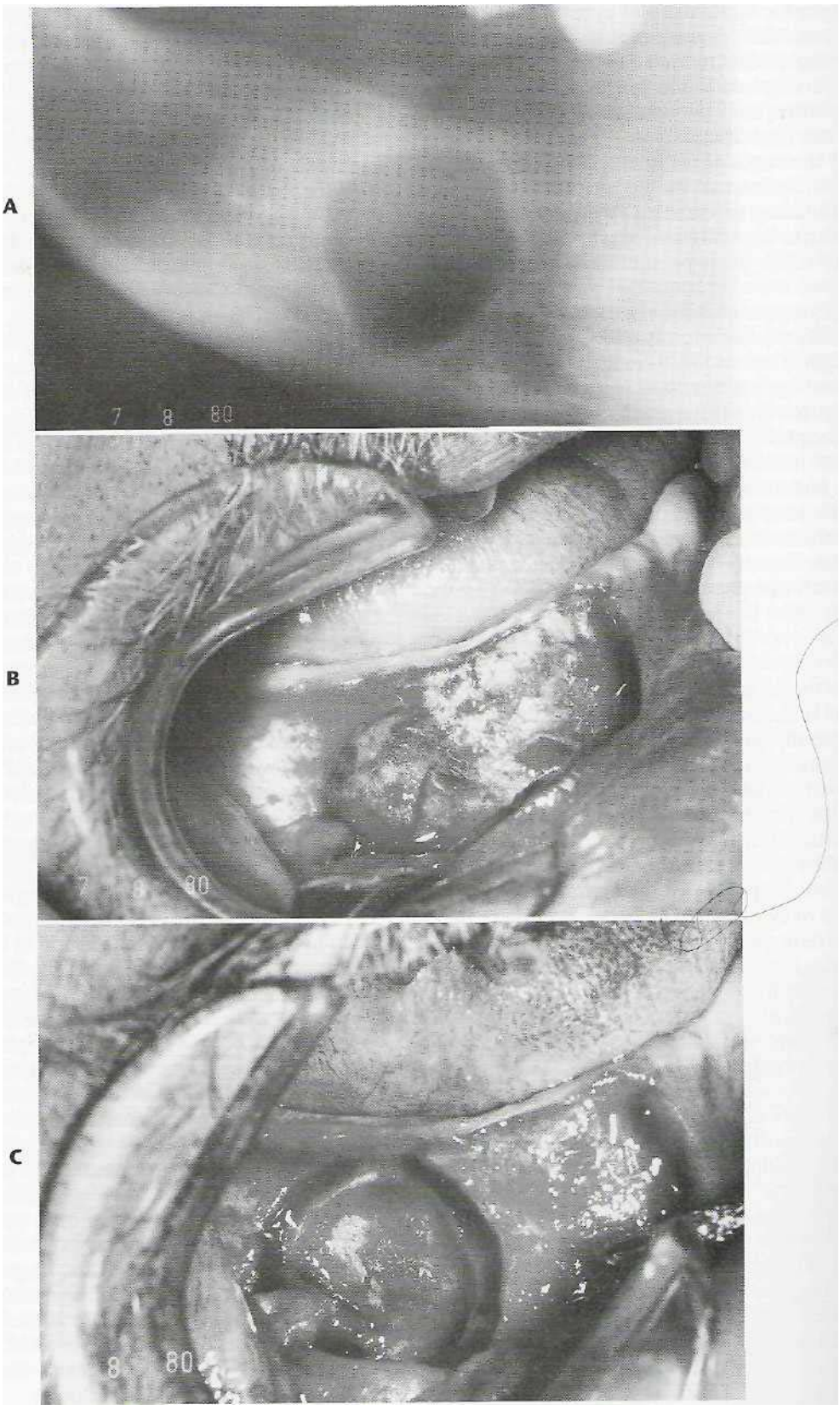


FIG. 22-2 A, Typical radiographic appearance of cyst. Radiolucent center is surrounded by zone of reactive bone. B, Expansion of buccal bone caused by underlying cyst. The proximity to mental neurovascular bundle (on distal and inferior aspect of cystic expansion) is demonstrated. C, Cystic cavity after removal of cyst is visualized. Mental nerve is left intact. The amount of osseous tissue is destroyed by cyst.

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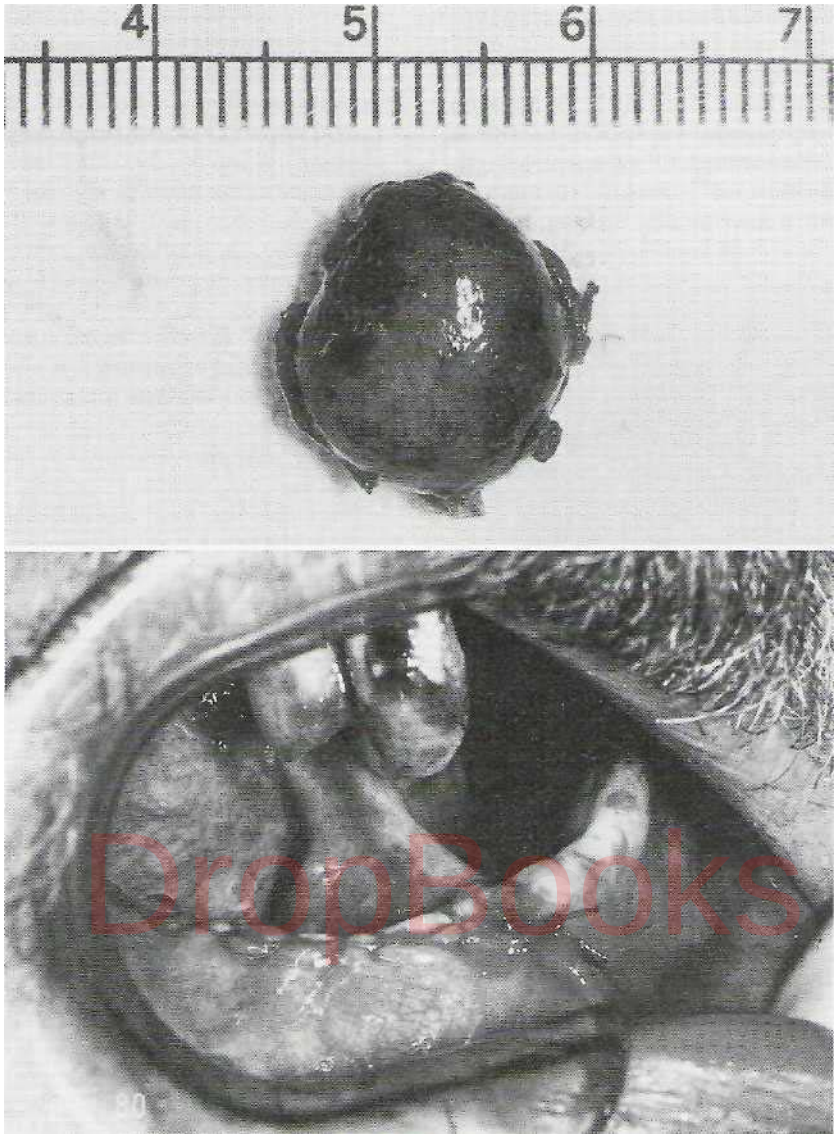

FIG. 22-2—cont'd **D,** Cyst with buccal bone still attached. E, Mucosal closure is demonstrated.

endodontic treatment of the teeth may be necessary in the near future, which may help to prevent odontogenic infection of the cystic cavity'from the necrotic dental pulp.

After enucleation, ^watertight primary closure should be obtained with appropriately positioned sutures. The bony cavity fills with a blood clot, which then organizes over time. Radiographic evidence of bone fill will take 6 to 12 months. Jaws that have been expanded by cysts slowly remodel to a more normal contour.

If the primary closure should break down and the wound dehiesce, the bony cavity should then be packed open to heal by secondary intention. The wound should be irrigated with sterile saline, and an appropriate length of strip gauze lightly impregnated with an antibiotic ointment should be gently packed into the cavity. This procedure is repeated every 2 to 3 days, gradually reducing the amount of packing until no more is necessary. Granulation tissue is seen on the bony walls in 3 to 4 days and slowly obliterates the cavity and obviates the need for packing. The oral epithelium then closes over the top of the opening, and osseous healing will progress.

Marsupiaiization

Marsupialization, decompression, and the Partsch operation all refer to creating a surgical window in the wall of the cyst, evacuating the contents of the cyst, and maintaining continuity between the cyst and the oral cavity, maxillary sinus, or nasal cavity (Fig. 22-5). The only portion of the cyst that is removed is the piece removed to produce the window. The remaining cystic lining is left in situ. This process decreases intracystic pressure and promotes shrinkage of the cyst and bone fill. Marsupialization can be used either as the sole therapy for a cyst or as a preliminary step in management, with enucleation deferred until later.

Indications. The following factors should be considered before deciding whether a cyst should be removed by marsupialization:

1. *Amount of tissue injury.* Proximity of a cyst to vital structures can mean unnecessary sacrifice of tissue if enucleation is used. For example, if enucleation of a cyst would create oronasal or oroantral fistulae or cause injury to major neurovascular structures (e.g., the inferior alveolar nerve) or devitalization of healthy teeth, marsupialization should be considered.
2. *Surgical access.* If access to all portions of the cyst is difficult, portions of the cystic wall may be left behind, which could result in recurrence. Marsupialization should therefore be considered.
3. *Assistance in eruption of teeth.* If an unerupted tooth that is needed in the dental arch is involved with the cyst (i.e., a dentigerous cyst), marsupialization may allow its continued eruption into the oral cavity (Fig.22-6).
4. *Extent of surgery.* In an unhealthy or debilitater patient, marsupialization is a reasonable alternative to enucleation, because it is simple and may be less stress ful for the patient.
5. *Size of cyst.* In very large cysts, a risk of jaw fracture during enucleation is possible. It may be better to marsupialize the cyst and defer enucleation until after considerable bone fill has occurred.

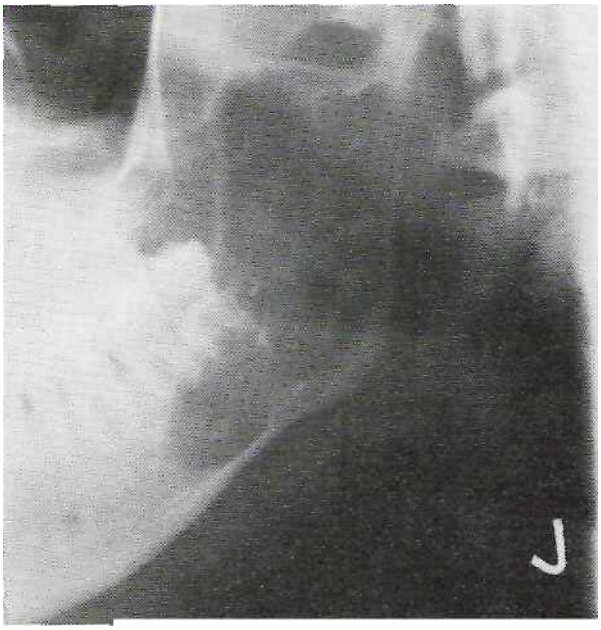

FIG. 22-3 Multilocular appearance of cyst. This lesion was diagnosed histologically as odontogenic keratocyst.

Advantages. The main advantage of marsupialization is that it is a simple procedure to perform. It may after spare vital structures from damage should immediate enucleation be attempted.

Disadvantages. The major disadvantage of marsupialization is that pathologic tissue is left in situ, without thorough histologic examination. Although the tissue taken in the window can be submitted for pathologic examination, a more aggressive lesion may be present in the residual tissue. Another disadvantage is that the patient is inconvenienced in several respects. The cystic cavity must be kept clean to prevent infection, because the cavity frequently traps food debris. In most instances this means that the patient must irrigate the cavity sever-

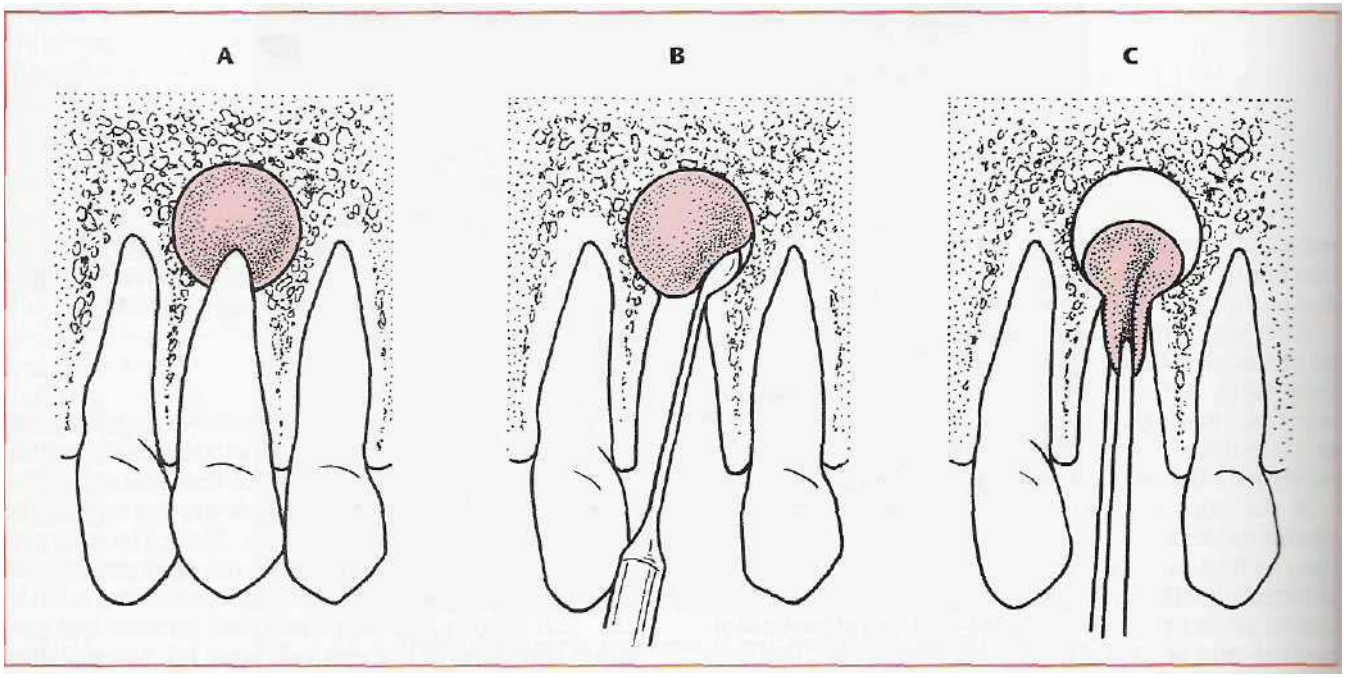

FIG. 22-4 Apical cystectomy performed at time of tooth removal. **A** to **C**, Removal with curette via tooth socket is visualized, **A** apical cystectomy must be performed with care because of proximity of apices of teeth to other structures, such as maxillary sinus and inferior alveolar canal.

Continued

al times every day with a syringe. This may continue for several months, depending on the size of the cystic cavity and the rate of bone fill.

Technique. Prophylactic systemic antibiotics are not usually indicated in marsupialization, although they should be used if the patient's health condition warrants it (see Chapters 1 and 2). After anesthetization of the area, the cyst is aspirated as discussed in Chapter 20. If the aspirate confirms the presumptive diagnosis of a cyst, the marsupialization procedure may proceed (Fig. 22-7). The initial incision is usually circular or elliptic and creates a large (1 cm or larger) window into the cystic cavity. If the bone has been expanded and thinned by the cyst, the initial incision may extend

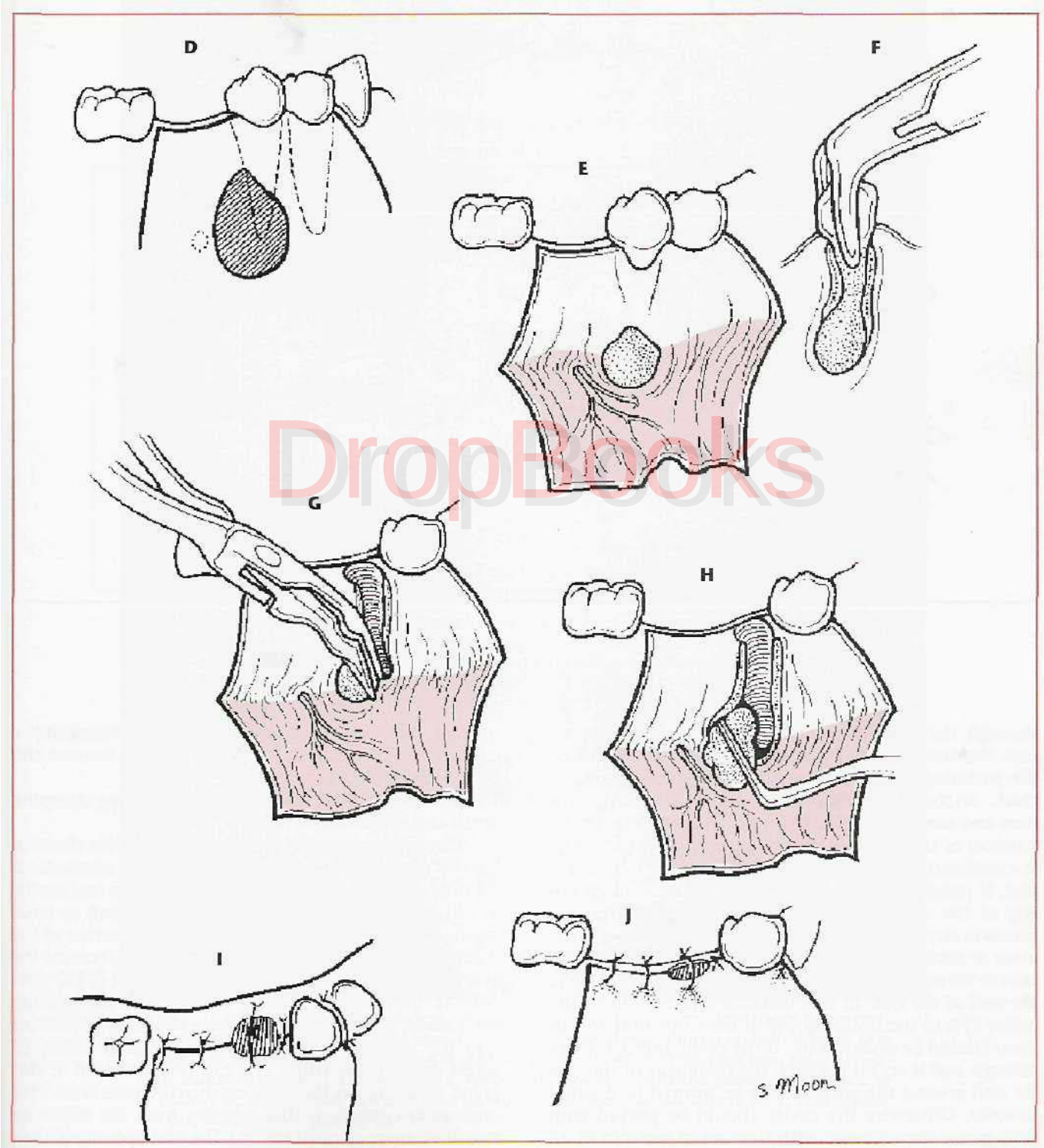

FIG. 22-4cont'd **D** to **J,** Removal of apical cyst by flap reflection and creation of osseous window is demonstrated at the time of tooth removal.

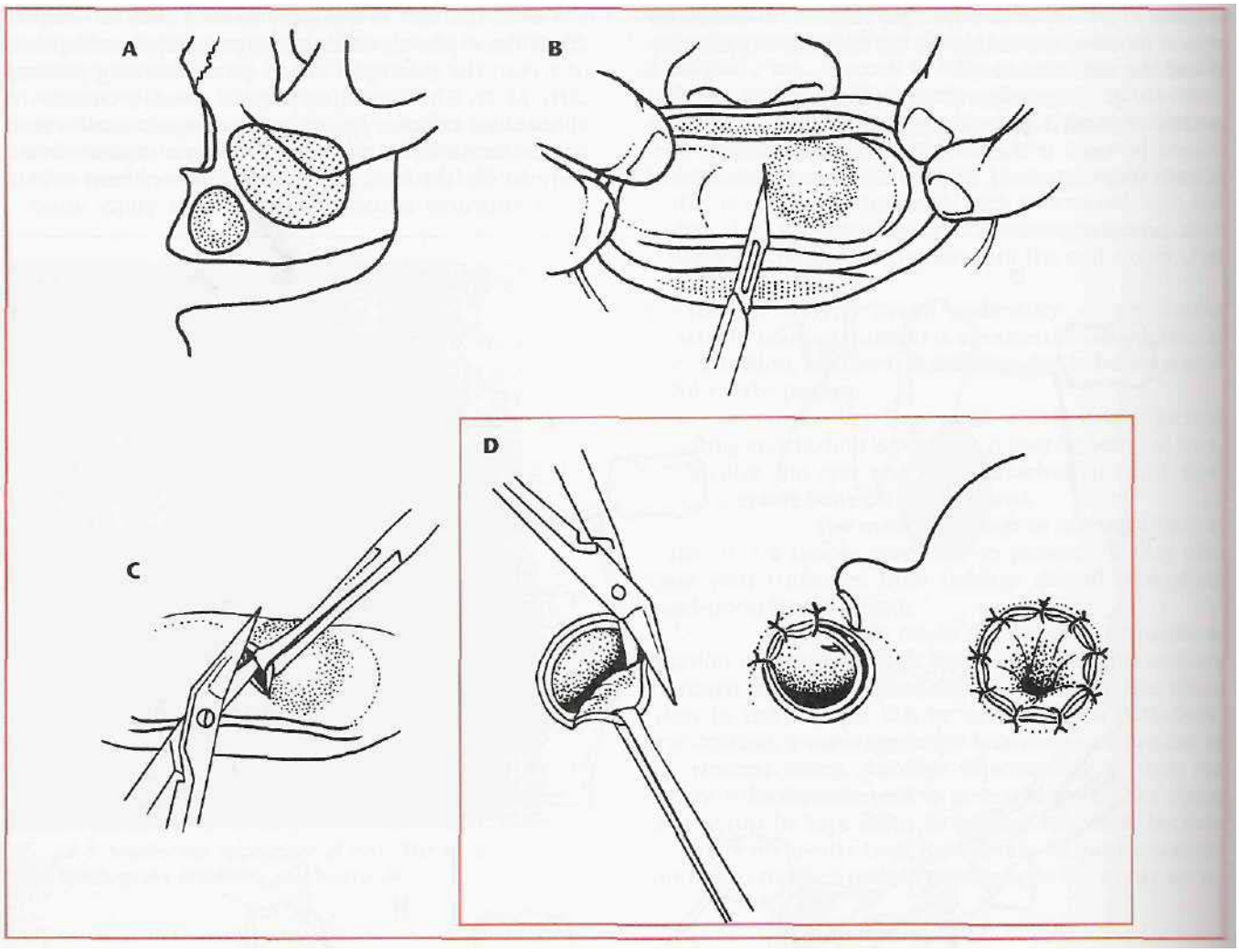

FIG. 22-5 Marsupialization technique. A, Cyst within maxilla. B, Incision through oral mucosa and cystic wall into center of cyst. C, Scissors used to complete excision of window of mucosa and cystic wall. D, Oral mucosa and mucosa of cystic wall sutured together around periphery of opening.

through the bone into the cystic cavity. If this is the case the tissue contents of the window are submitted for pathologic examination. If the overlying bone is thick, an osseous window is removed carefully with burs and rongeurs. The cyst is then incised to remove a window of the lining, which is submitted for pathologic examination. The contents of the cyst are evacuated, and, if possible, visual examination of the residual lining of the cyst is undertaken. Irrigation of the cyst removes any residual fragments of debris. *Areas ofulcer-ation or thickening of the cystic wall should alert the clinician to the possibility of dysplastic or neoplastic changes in the wall of the cyst.* In this instance enueleation of the entire cyst or incisional biopsy of the suspicious area or areas should be undertaken . If the cystic lining is thick enough and if access permits, the perimeter of the cystic wall around the window can be sutured to the oral mucosa. Otherwise the cavity should be packed with strip gauze impregnated with tincture of benzoin or an antibiotic ointment. This packing must be left in place for 10 to 14 days to prevent the oral mucosa from healing over the cystic window. By 2 weeks the lining of the cyst should be healed to the oral mucosa around the periphery of the window.

Careful instructions to the patient regarding cleaning of the cavity are necessary.

When marsupializing cysts of the maxilla, the clinician_ has two choices of where the cyst will become exteriorized: (1) the cyst may be surgically opened into the oral cavity as just described, or (2) into the maxillary sinus or nasal cavity. For cysts that have destroyed a large portion of the maxilla and encroached on the antrum or nasal cavity, cyst may be approached from the facial aspect of the alveolus, as just described. Once a window into the cyst has been made, a second unroofing can be widely performed into the adjacent maxillary antrum or nasal cavity (If access permits, the entire cyst can be enucleated at this point, which allows the cystic cavity to become lined with respiratory epithelium that migrates from the adjoining maxillary sinus or nasal cavity.) The oral opening is then closed and permitted to heal. The cystic lining is thereby continuous with the lining of the antrum or nasal Cavity.

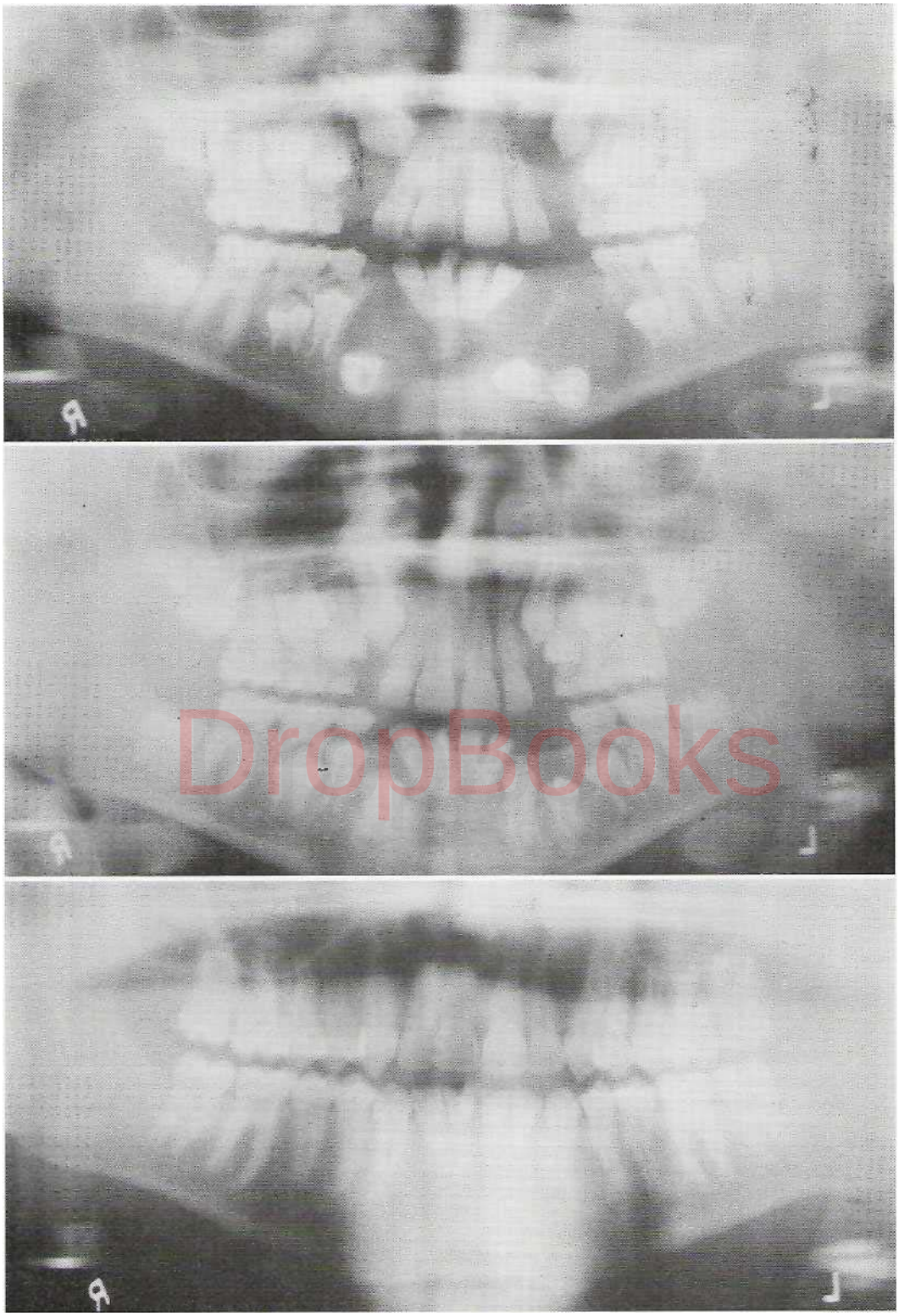

FIG. 22-6 Marsupialization of multiple dentigerous cysts. A, Radiographic appearance before mar-supialization. Marsupialization was carried out along crest of alveolar process on both sides. B, One year later, the uprighting and eruption of teeth are demonstrated. C, Three years later. No orthodontic assistance was required. (From Ellis E, Fonseca R): Therapy of cysts and odontogenic tumors. In Thawley SE et al, editors: *Comprehensive management of head and neck tumors,* ed 2, Philadelphia, 1999, WB Saunders; courtesy Dr. Timothy Pickens, Ypsilanti, MI.)

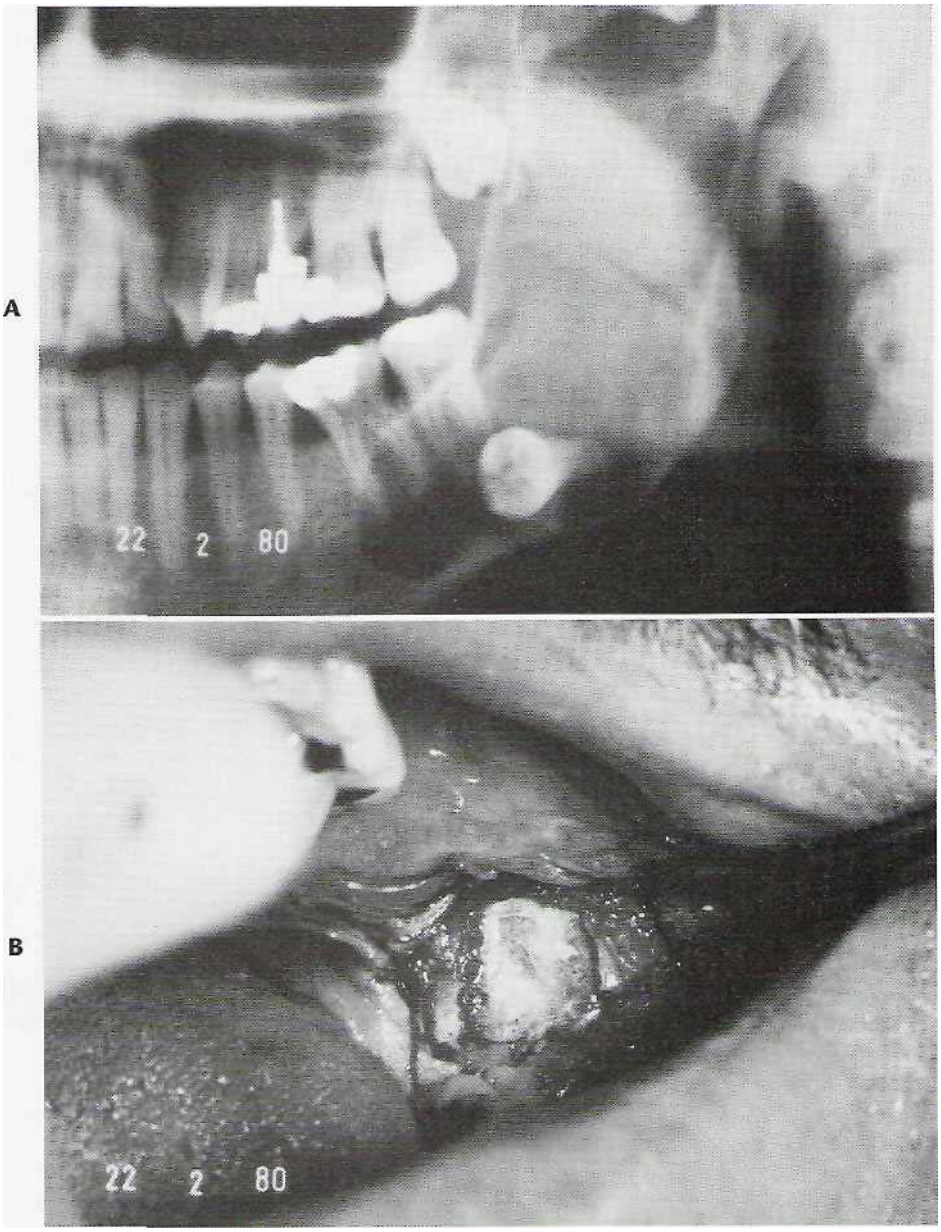

FIG. 22-7 This case combined marsupialization with subsequent enucleation. A, Radiographic appearance of lesion and displaced tooth on initial examination. B, Mucosa reflected from anterior border of ascending ramus. Osseous window created by use of round bur; bone was gently removed, exposing underlying fibrous cystic wall (white membrane). Circular piece of this cystic wall was removed, exposing cystic lumen. Cystic mucosa was then sutured to oral mucosa around periphery of osseous window. Osseous window and cystic specimen were submitted for pathologic examination.

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Marsupialization is rarely used as the sole form of treatment for cysts. In most instances enucleation is done after marsupialization. In the case of a dentigerous cyst, however, there may not be any residual cyst to remove once the tooth has erupted into the dental arch. In addition, if further surgery is contraindicated because of concomitant medical problems, marsupialization may be performed without future enucleation. The cavity may or may not obliterate totally with time. If it is kept clean, the cavity should not become a problem.

Enucleation after Marsupialization

Enucleation is frequently done (at a later date) after marsupialization. Initial healing is rapid after marsuplalization, but the size of the cavity may not decrease appreciably past a certain point. The objectives of the marssupialization procedure have been accomplished at this time, and a secondary enucleation may be undertaken withoutinjury to adjacent structures. The combined approach reduces morbidity and accelerates complete healing of the defect.

FIG. 22-7—cont'd C, Appearance at 13 months of opening created into cyst. The patient had irrigated lumen twice a day. D, Radiographic appearance at 1 3 months. The extent of bone regeneration (compared with Fig. 21-7, *A)* is visualized. Now ample osseous tissue surrounds inferior alveolar neurovascuiar bundle to prevent damage during enucleation.

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Indications. The indications for this combined modality of surgical therapy are the same as those listed for the technique of marsupialization. These indications are predicated on a thorough evaluation of the amount of tissue injury enucleation would cause, the degree of access for enucleation, whether or not impacted teeth associated with the cyst would benefit from eruptional guidance with marsupialization, the medical condition of the patient, and the size of the lesion. However, if the cyst does not totally obliterate after marsupialization, enucleation should be considered. Another indication for enucleation of a previously marsupialized cyst is a cystic cavity that the patient is finding difficult to cleanse. The clinician may also desire to examine the entire lesion histologically.

Advantages. The advantages of combined marsupialization and enucleation are the same as those listed for marsupialization *and* enucleation. In the marsupialization phase, the advantage is that this is a simple procedure that spares adjacent vital structures. In the enucleation phase, the entire lesion becomes available for histologic examination. Another advantage is the development of a thickened cystic lining, which makes the secondary enucleation an easier procedure.

Disadvantages. The disadvantages of this modality of surgical intervention are the same as those for marsupialization. The total cyst is not removed initially for pathologic examination. However, subsequent enucleation may then detect any occult pathologic condition.

Technique. The cyst is first marsupialized, and osseous healing is allowed to progress. Once the cyst has decreased to a size that makes it amenable to complete surgical removal, enucleation is performed as the definitive treatment. The appropriate time for enucleation is when bone is covering adjacent vital structures, which prevents their injury during enucleation, and when adequate bone fill has provided enough strength to the jaw to prevent fracture during enucleation (see Fig. 22-7).

The initial incisions for enucleation of the cyst differ, however, from those when the cyst is not first marsupialized. The cyst has a common epithelial lining with the oral cavity after marsupialization. The window initially made into the cyst contains the epithelial bridge between the cystic cavity and the oral cavity. This epithelium *must* be removed completely with the cystic lining; an elliptic incision completely encircling the window must be made down to sound bone. The clinician then has the opportunity to begin stripping the cyst from the window into the cystic cavity. The plane of dissection is easily estab-

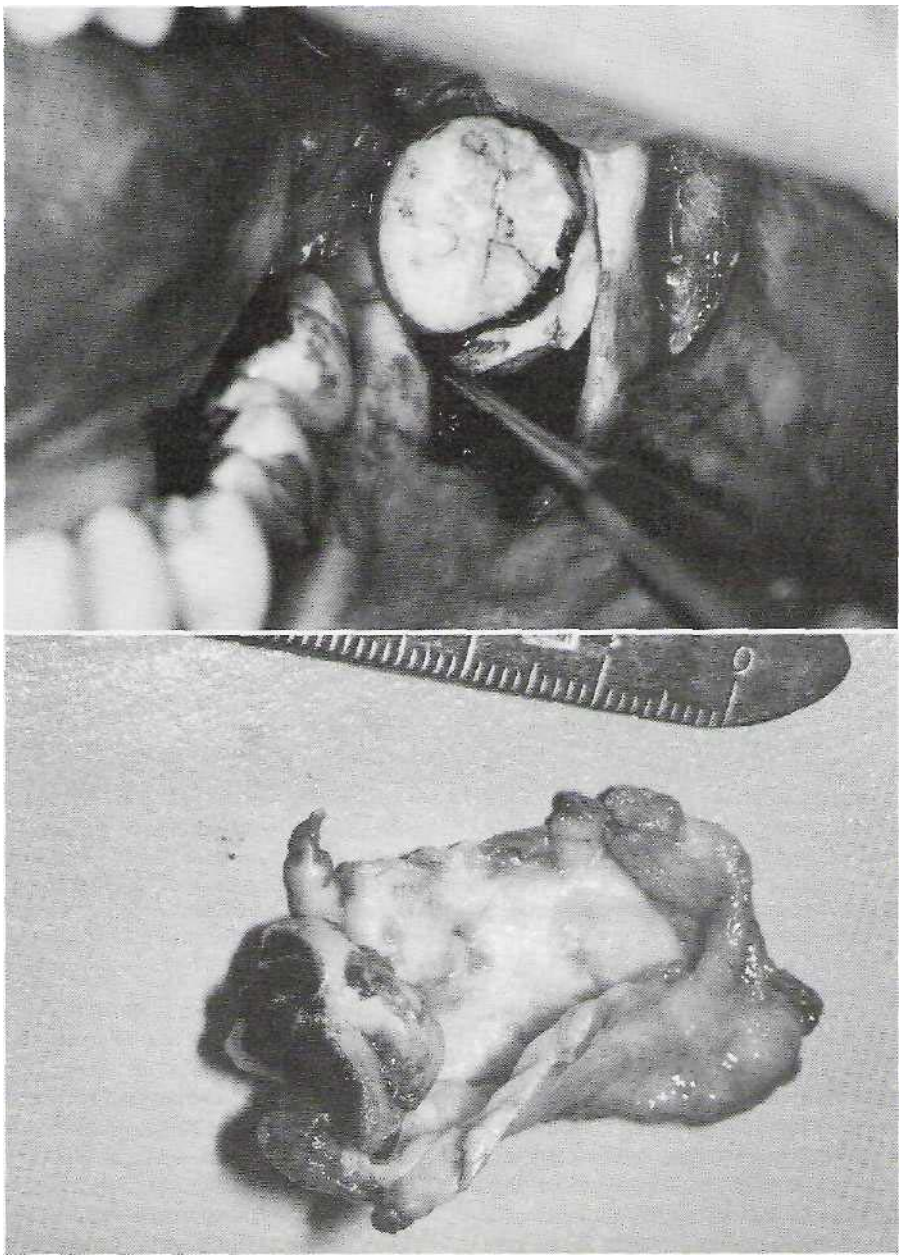

FIG. 22-7—cont'd E, Cystectomy easily performed 1 3 months after initial marsupialization. Tooth being removed with cystic wall. The thickness of cystic wall is demonstrated. F, Specimen after removal.

lished with this approach, and the cyst can be enucleated without difficulty.

Once the cyst has been enucleated, the oral soft tissues must be closed over the defect, if possible, which may require the development and mobilization of soft tissue flaps that can be advanced and sutured in a watertight manner over the osseous window. If complete closure of the wound cannot be achieved, packing the cavity with strip gauze impregnated with an antibiotic ointment is acceptable. This packing must be changed repeatedly with cleansing of the cavity until granulation tissue has obliterated the opening and epithelium has closed over the wound.

Enucleation with Curettage

Enucleation with curettage means that after enucleation a curette or bur is used to remove 1 to 2 mm of bone around the entire periphery of the cystic cavity. This is done to remove any remaining epithelial cells that may be present in the periphery of the cystic wall or bony cavity. These cells could proliferate into a recurrence of the cyst.

Indications. The clinician should perform curettage with enucleation in two instances: The first instance is if the clinician is removing an odontogenic keratocyst. In this case the more aggressive approach of enucleation with curettage should be used, because odontogenic keratocysts exhibit aggressive clinical behavior and a markedly high rate of recurrence.[1] Reported recurrence rates have been between 20% and 60%.[2] Reasons for locally aggressive behavior are based on the increased mitotic activities and cellularity of the odontogenic keratocyst's epithelium.[3"5] Daughter, or satellite, cysts found in the periphery of the main cystic lesion may be incompletely removed, which contributes to the increased rate of recurrence. The cystic lining is usually very thin and readily fragmented, making thorough enucleation difficult. Therefore when an odontogenic keratocyst is clinically suspected, the minimal treatment should be careful enucleation with aggressive curettage of the bony cavity.

Should the lesion recur, treatment must be predicated on the following factors: If the area is accessible, another attempt at enucleation could be undertaken; if inaccessible, bony resection with 1-cm margins should be considered. Whatever the treatment, the patient must be followed closely for recurrence, because odontogenic keratocysts have recurred years after treatment.

The second instance in which enucleation with curettage is indicated is with any cyst that recurs after what was deemed a thorough removal. The reasons for curettage in this case are the same as those outlined previously.

Advantages. If enucleation leaves epithelial remnants, curettage may remove them, thereby decreasing the likelihood of recurrence.

Disadvantages. Curettage is more destructive of adjacent bone and other tissues. The dental pulps may be stripped of their neurovascular supply when curettage is performed close to the root tips. Adjacent neurovascular bundles can be similarly damaged. Curettage must always be performed with great care to avoid these hazards.

Technique. After the cyst has been enucleated and removed, the bony cavity is inspected for proximity to adjacent structures. A sharp curette or a bone bur with sterile irrigation can be used to remove a 1- to 2-mm layer of bone around the complete periphery of the cystic cavity. This should be done with extreme care when working proximal to important anatomic structures. The cavity is then cleansed and closed.

PRINCIPLES OF SURGICAL MANAGEMENT OF JAW TUMORS

A discussion of the surgical management of jaw tumors is made easier by the fact that many tumors behave similarly and therefore can be treated in a similar manner. The three main modalities of surgical excision of jaw tumors are (1) enucleation (with or without curettage), (2) marginal (i.e., segmental) or partial resection, and (3) composite resection (Box 22-1). Many benign tumors behave nonaggressively and are therefore treated conservatively with enucleation, curettage, or both (Table 22-1). Another group of benign oral tumors behaves more aggressively and requires margins of uninvolved tissue to lessen the chance of recurrence. Marginal (i.e., segmental) or partial resection is used for removal of these lesions (Fig. 22-8). The last group of tumors includes the malignant varieties. These tumors require more radical intervention, with wider margins of uninvolved tissue. Surgery may include the removal of adjacent soft tissues and dissection of lymph nodes. Radiotherapy, chemotherapy, or both, either alone or *in* addition to surgery, may be used.

BOX 22-1

Types of Surgical Operations Used for the Removal of Jaw Tumors

A. Enucleation and/or curettage: Local removal of tumor by instrumentation in direct contact with the lesion. Used for very benign types of lesions.
B. Resection: Removal of a tumor by incising through uninvolved tissues around the tumor, thus delivering the tumor without direct contact during instrumentation (also known as *en bloc* resection).
   1. Marginal (i.e., segmental) resection: Resection of a tumor without disruption of the continuity of the bone.
   2. Partial resection: Resection of a tumor by removing a full-thickness portion of the jaw. (In the mandible, this can vary from a small continuity defect to a hemimandibulectomy. Jaw continuity is disrupted.)
   3. Total resection: Resection of a tumor by removal of the involved bone (e.g., maxillectomy and mandibulectomy).
   4. Composite resection: Resection of a tumor with bone, adjacent soft tissues, and contiguous lymph node channels. (This is an ablative procedure used most commonly for malignant tumors.)

TABLE 22-1

Types of Jaw Tumors and Primary Treatment Modalities

Enucleation and/or Curettage	Marginal or Partial Resection	Composite Resection*
Odontogenic tumors		
Odontoma	Ameloblastoma	Malignant ameloblastoma
Ameloblastic fibroma ameloblastic fibroodontoma	Calcifying epithelial odontogenic tumor	Ameloblastic fibrosarcoma
		Ameloblastic odontosarcoma
Adenomatoid odontogenic tumor	Myxoma	Primary intraosseous carcinoma
Calcifying odontogenic cyst	Ameloblastic odontoma	
Cementoblastoma	Squamous odontogenic tumor	
Central cementifying fibroma		
Fibroosseous lesions		
Central ossifying fibroma	Benign chondroblastoma	Fibrosarcoma
Fibrous dysplasia (if necessary)		Osteosarcoma
Cherubism (if necessary)		Chondrosarcoma
Central giant cell granuloma		Ewing's sarcoma
Aneurysmal bone cyst		
Osteoma		
Osteoid osteoma		
Osteoblastoma		
Other lesions		
Hemangioma	Hemangioma	Lymphomas
Eosinophilic granuloma		Intraosseous salivary gland malignancies
Neurilemmoma		Neurofibrosarcoma
Neurofibroma		Carcinoma that has invaded jaw
Pigmented neuroectodermal tumor		

Note: These are generalities. Treatment is individualized for each patient and each lesion.

*These lesions are malignancies and may be treated variably. For lesions totally within the jaw, partial resection may be performed without adjacent soft tissue and lymph node dissections. Radiotherapy and chemotherapy may also play a role in the overall therapy.

Besides cysts, the most common jaw lesions the dentist encounters either are inflammatory in nature or benign neoplasms. Most of them lend themselves to removal by simple excisional biopsy techniques. However, more aggressive lesions are occasionally encountered, and several factors must be used to determine the most appropriate type of therapy. The most important of these factors is the aggressiveness of the lesion. Other factors that must be evaluated before surgery are the anatomic location of the lesion, its confinement to bone, the duration of the lesion, and the possible methods for reconstruction after surgery.

Aggressiveness of Lesion

Surgical therapy of oral lesions ranges from enucleation or curettage to composite resection. Histologic diagnosis positively identifies and therefore directs the treatment of the lesion. Because of the wide range in behavior of oral lesions, the prognosis is related more to the histologic diagnosis, which indicates the biologic behavior of the lesion, than to any other single factor.

Anatomic Location of Lesion

The location of a lesion within the mouth or perioral areas may severely complicate surgical excision and therefore jeopardize the prognosis. A nonaggressive, benign lesion in an inaccessible area, such as the pterygomaxillary fissure, presents an obvious surgical problem. Conversely, a more aggressive lesion in an easily accessible and resectable area, such as the anterior mandible, often offers a better prognosis.

Maxilla versus mandible. Another important consideration with some oral lesions, such as the more aggressive odontogenic tumors and carcinomas, is whether they are within the mandible or the maxilla. The adjacent maxillary sinuses and nasopharynx allow tumors of the maxilla to grow asymptomatically to large sizes, with symptoms occurring late. Thus maxillary tumors produce a poorer prognosis than those within the mandible.

Proximity to adjacent vital structures. The proximity of benign lesions to adjacent neurovascular structures and teeth is an important consideration, because preservation of these structures should be attempted. Frequently

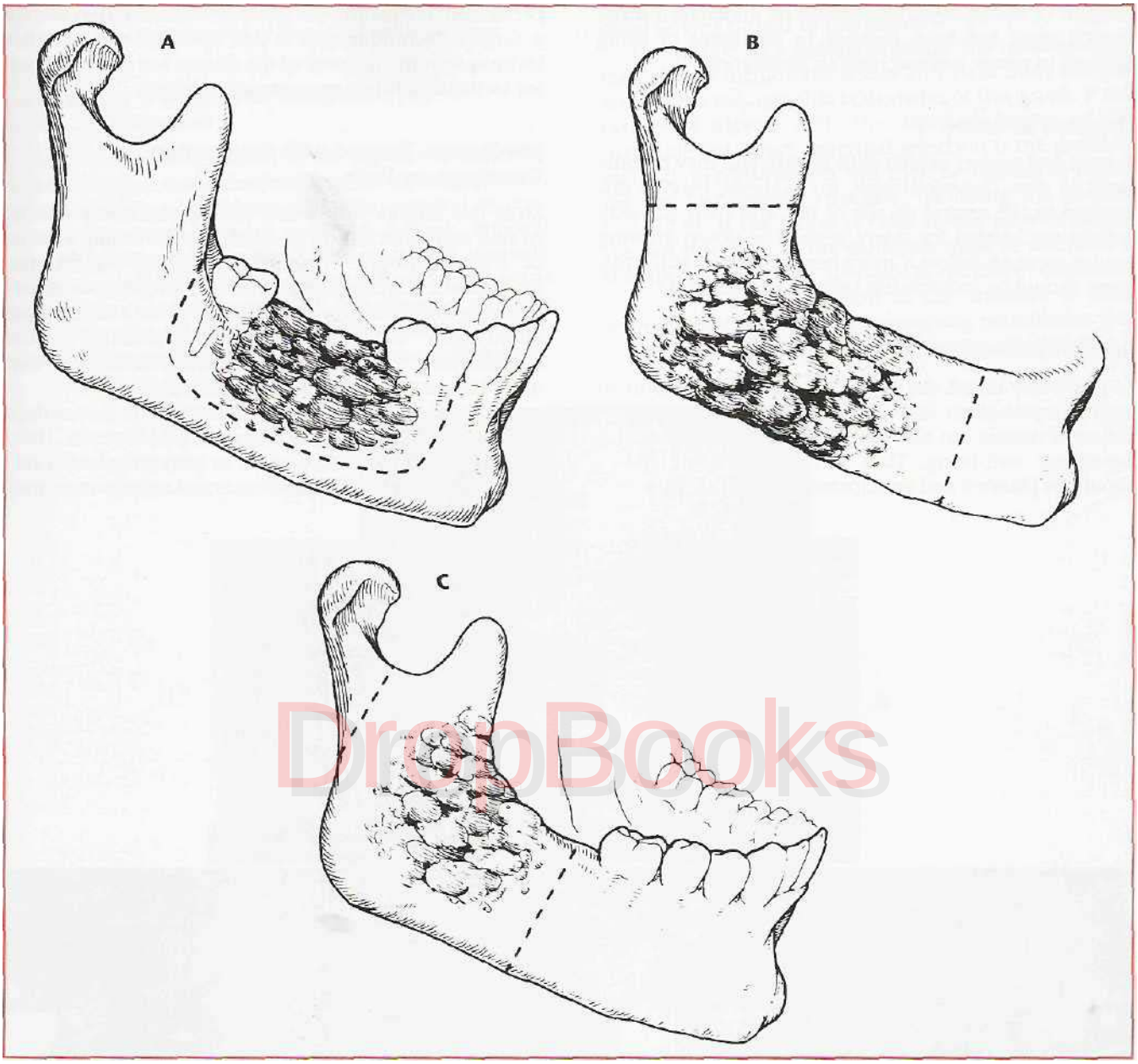

FIG. 22-8 Common types of mandibular resection. A, Marginal or segmental resection, which does not disrupt mandibular continuity. B and C, Partial mandibular resections, which disrupt mandibular continuity. Attempts to leave mandibular condyle to facilitate reconstruction are demonstrated.

the apices of adjacent tooth roots are completely uncovered during a surgical procedure. The dental pulps are stripped of their blood supply. These teeth should be considered for endodontic treatment to prevent an odontogenic infection, which would complicate healing and jeopardize the success of bone grafts placed in an adjacent area.

Size of tumor. The amount of involvement within a particular site, such as the body of the mandible, has a bearing on the type of surgical procedure necessary to obtain a cure with the more aggressive lesions. When possible the inferior border of the mandible is left intact to maintain continuity. This can be accomplished by marginal resection of the involved area. When the tumor extends through the entire thickness of the involved jaw, a partial resection becomes mandatory.

Intraosseous versus extraosseous location. An aggressive oral lesion confined to the interior of the jaw, without perforation of the cortical plates, offers a better prognosis than one that has invaded surrounding soft tissues. Invasion of soft tissues indicates a more aggressive tumor, which, because of its presence in soft tissues, makes complete removal more difficult and sacrifices more normal tissues. In the latter case the soft tissue in the area of the perforation should be locally excised. A supraperiosteal

excision of the involved jaw should be undertaken if the cortical plate has been thinned to the point of being eggshell in nature without obvious perforation.

Duration of Lesion

Several oral tumors exhibit slow growth and may become static in size. The odontomas, for example, may be discovered in the second decade of life, and their size may remain unchanged for many years. The slower-growing lesions seem to follow a more benign course, and treatment should be individually tailored to each case.

Reconstructive Efforts

As previously noted, the goal of any surgical procedure to remove a pathologic lesion should not only be the eradication of disease but also the facilitation of the patient's functional well-being. Thus reconstructive procedures should be planned and anticipated *before* initial surgery is performed. Frequently the goals of reconstruction dictate a surgical technique that is just as effective as another technique in the removal of the disease but more optimal for facilitating future reconstructive efforts.

Jaw Tumors Treated with Enucleation, Curettage, or Both

Most jaw tumors with a low rate of recurrence can be treated with enucleation or curettage; for example, most of the odontogenic tumors, including odontomas, ameloblastic fibromas, ameloblastic fibroodontomas, keratinizing and calcifying odontogenic cysts, adenomatoid odontogenic tumors, cementoblastomas, and central cementifying (i.e., ossifying) fibromas. Table 22-1 lists other lesions that are treated in this manner.

Technique The technique for enucleation or curettage of jaw tumors is not unlike that described for cysts. However, additional procedures, such as sectioning large calcified masses with burs in odontomas and cementomas, may

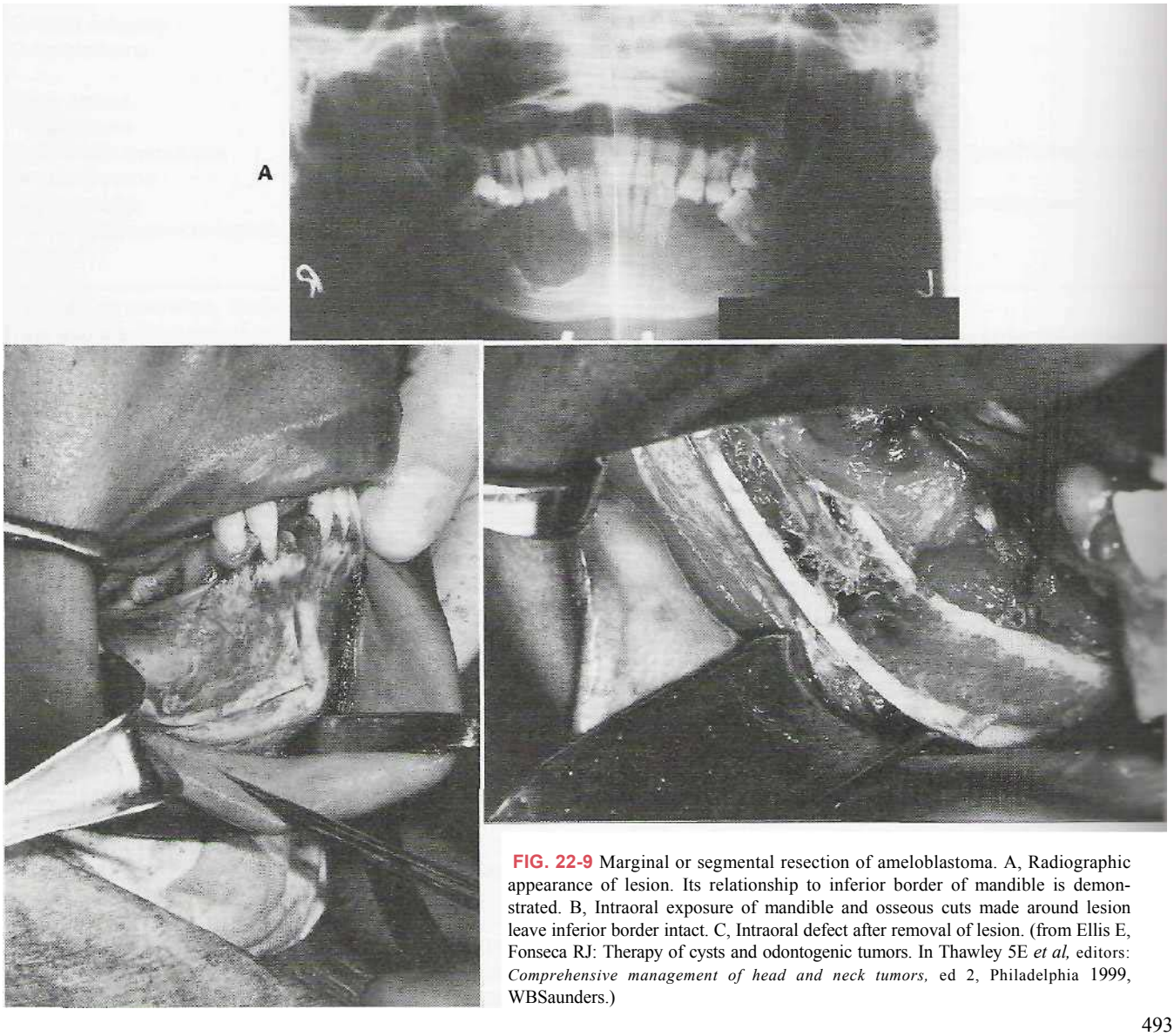

FIG. 22-9 Marginal or segmental resection of ameloblastoma. A, Radiographic appearance of lesion. Its relationship to inferior border of mandible is demonstrated. B, Intraoral exposure of mandible and osseous cuts made around lesion leave inferior border intact. C, Intraoral defect after removal of lesion. (from Ellis E, Fonseca RJ: Therapy of cysts and odontogenic tumors. In Thawley 5E *et al,* editors: *Comprehensive management of head and neck tumors,* ed 2, Philadelphia 1999, WBSaunders.)

be required. In these instances the principles discussed in Chapter 9 for the removal of impacted teeth are used.

Jaw Tumors Treated with Marginal or Partial Resection

When the lesion is known to be aggressive, either by histopathologic determination or by its clinical behavior, or it is of such a consistency that total removal by enucleation, curettage, or both would be difficult, removal may be facilitated by resecting the lesion with adequate bony margins. Odontogenic lesions treated in this manner are the ameloblastoma, the odontogenic myxoma (i.e., fibromyxomas), the calcifying epithelial odontogenic tumor (i.e., Pindborg), the squamous odontogenic tumor, and the ameloblastic odontoma. Table 22-1 lists other lesions treated in this manner.

Technique. As a general principle the resected specimen should include the lesion and 1-cm bony margins around the radiographic boundaries of the lesion. If this can be achieved with the inferior border of the mandible left intact, marginal resection is the preferred method. Reconstruction will then be limited to replacing the lost osseous structure, including the alveolus (Fig. 22-9). If the lesion is close to the inferior border, the full thickness of the mandible must be included in the specimen, which disrupts mandibular continuity (Fig. 22-10). Reconstruction in this instance is much more difficult, because the remaining mandibular fragments must be secured in their proper relationship to

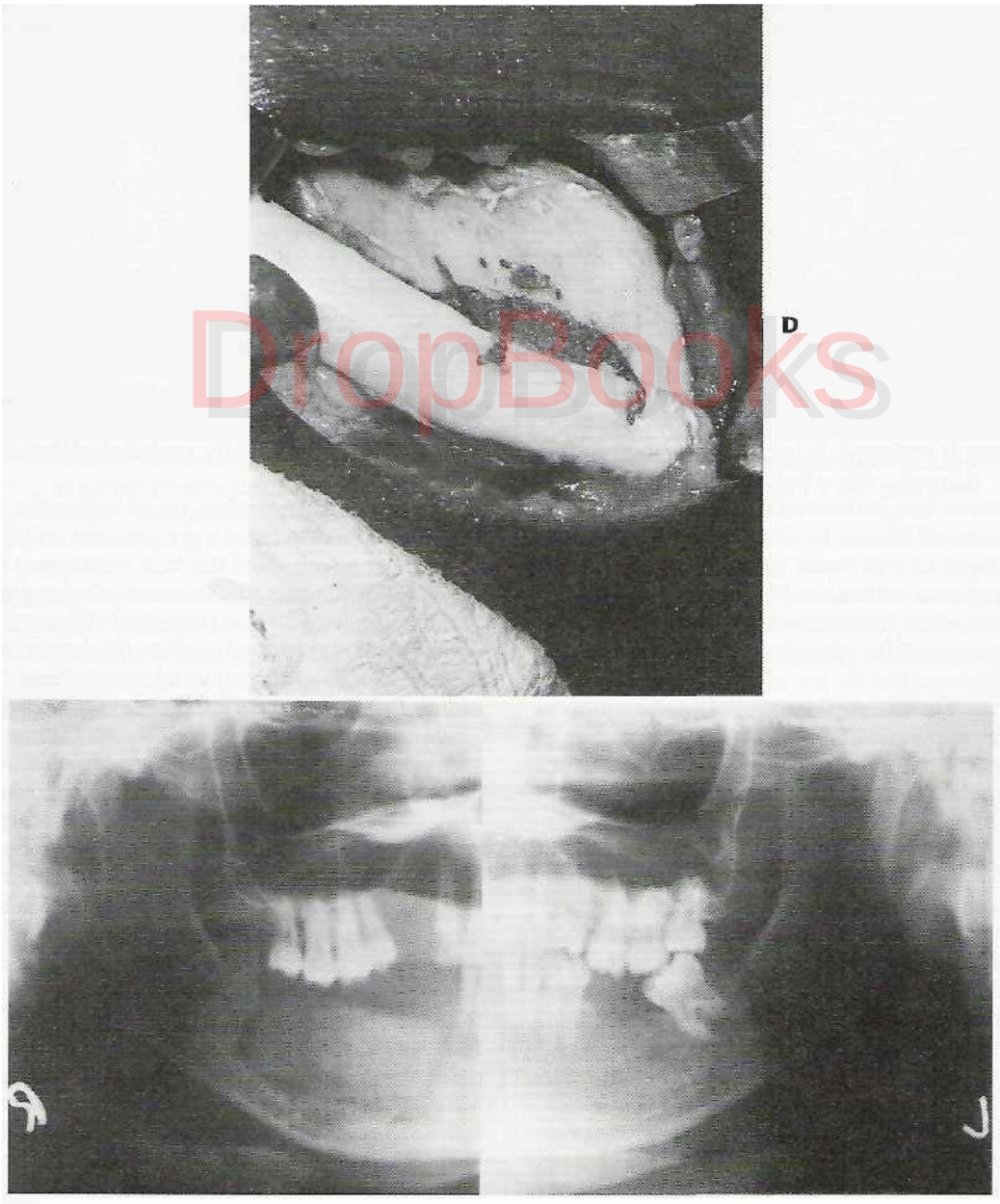

FIG. 22-9 —cont d **D,** Extraoral exposure and placement of bone graft to reconstruct mandibular alveolus. **E**, Radiographic appearance immediately after graft placement.

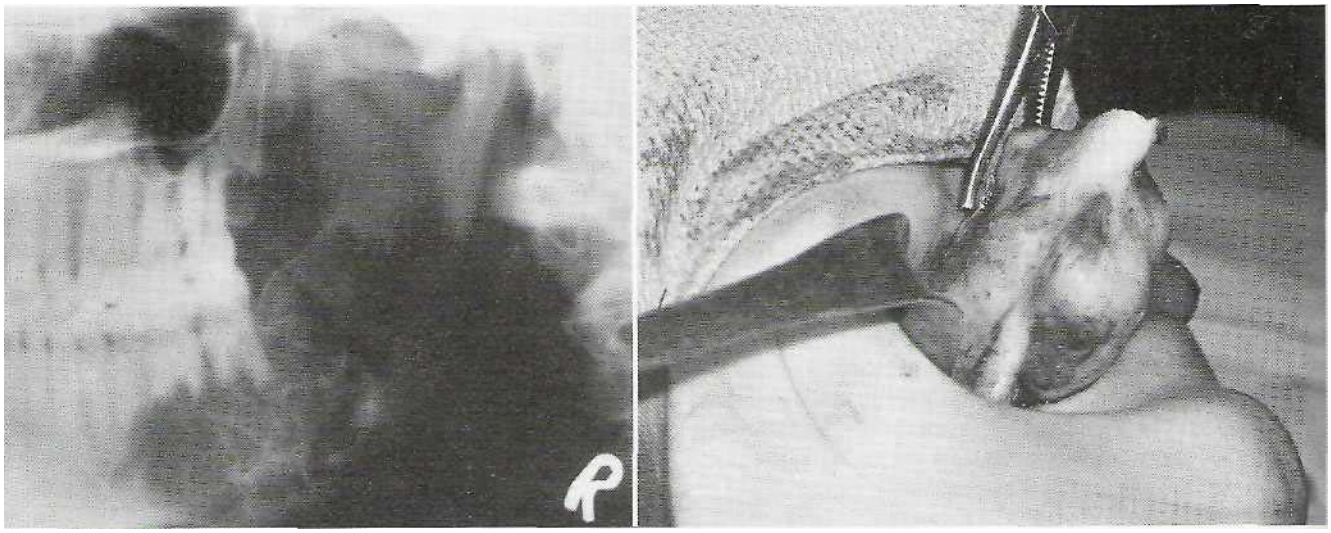

FIG. 22-10 Partial mandibular resection of myxoma. A, Radiographic appearance on initial presentation. B, Photograph of intraoral resection of tumor (surgical resection similar to that shown in Fig. 22-8, 6). (B from Ellis E, Fonseca Rj: Therapy of cysts and odontogenic tumors. In Thawley SE et al, editors: *Comprehensive management of head and neck tumors,* ed 2, Philadelphia, 1999, WB Saunders.)

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one another for proper function and symmetry to be restored.

The surgical technique for marginal (i.e., segmental) resection is relatively straightforward. A full-thickness mucoperiosteal flap is developed and stripped from the bone to be removed. Air-driven surgical saws or burs are then used to section the bone in the planned locations, and the segment is removed. Whenever marginal or partial resection is used, the clinician must determine whether the tumor has perforated the cortical plates and invaded adjacent soft tissues, in which case it is necessary to sacrifice a layer of soft tissue to eradicate the tumor, and a supraperiosteal dissection of the involved bone is performed. Immediate reconstruction is more difficult, because there may not be enough remaining soft tissues to close over bone grafts.

If the clinician is concerned about the adequacy of the soft tissue surgical margins around a lesion when surgery is being performed in a hospital setting, specimens along the margins can be removed and sent immediately to the pathologist for histopathologic examination. This process is performed in approximately 20 minutes by freezing the tissue in liquid carbon dioxide or nitrogen and then sectioning and staining the tissue for immediate examination. The accuracy of "frozen-section" examination is good when used for detecting adequacy of surgical margins. However, it is less accurate when trying to diagnose a lesion histopathologically for the first time.

MALIGNANT TUMORS OF THE ORAL CAVITY

Malignancies of the oral cavity may arise from a variety of tissues, such as salivary gland, muscle, and blood vessels, or may even present as metastases from distant sites. Most common, however, are epidermoid carcinomas of the oral mucosa, which are the form of cancer that the dentist is in a position to discover first by doing thorough oral examinations. The seriousness of an oral malignancy can vary from the necessity for a simple excisional biopsy to composite jaw resection with neck dissection (i.e.. removal of the lymph nodes and other visceral structures adjacent to lymph node channels in neck) to affect a cure. Because of the variation in clinical presentation. *clinical staging* is usually undertaken before a treatment plan is formulated.

Clinical staging refers to assessing the extent of the disease before undertaking treatment and has as two purposes: (1) selection of the best treatment, and (2) meaningful comparison of the end results reported from different sources. Clinical staging of the lesion is performed for several varieties of oral malignancies, including epidermoid carcinomas and oral lymphomas. Staging is performed differently for each type of malignancy and may involve extensive diagnostic tests, such as radiographs blood tests, and even surgical exploration of other body areas to evaluate the extent of possible tumor metastasis Once the tumor is staged, treatment is formulated. Several types of malignancies have well-defined treatment protocols that have been designed by surgeons and oncologists in an effort to study the effectiveness of treatment regimens more carefully.

Treatment Modalities for Malignancies

Malignancies of the oral cavity are treated with surgery, radiation, chemotherapy, or a combination of these modalities. The treatment for any given case depends on several factors, including the histopathologic diagnosis, the location of the tumor, the presence and degree of metastasis, the radio sensitivity or chemosensitivity of the tumor, the age and general physical condition of the patient, the experience of the treating clinicians, and the wishes of the

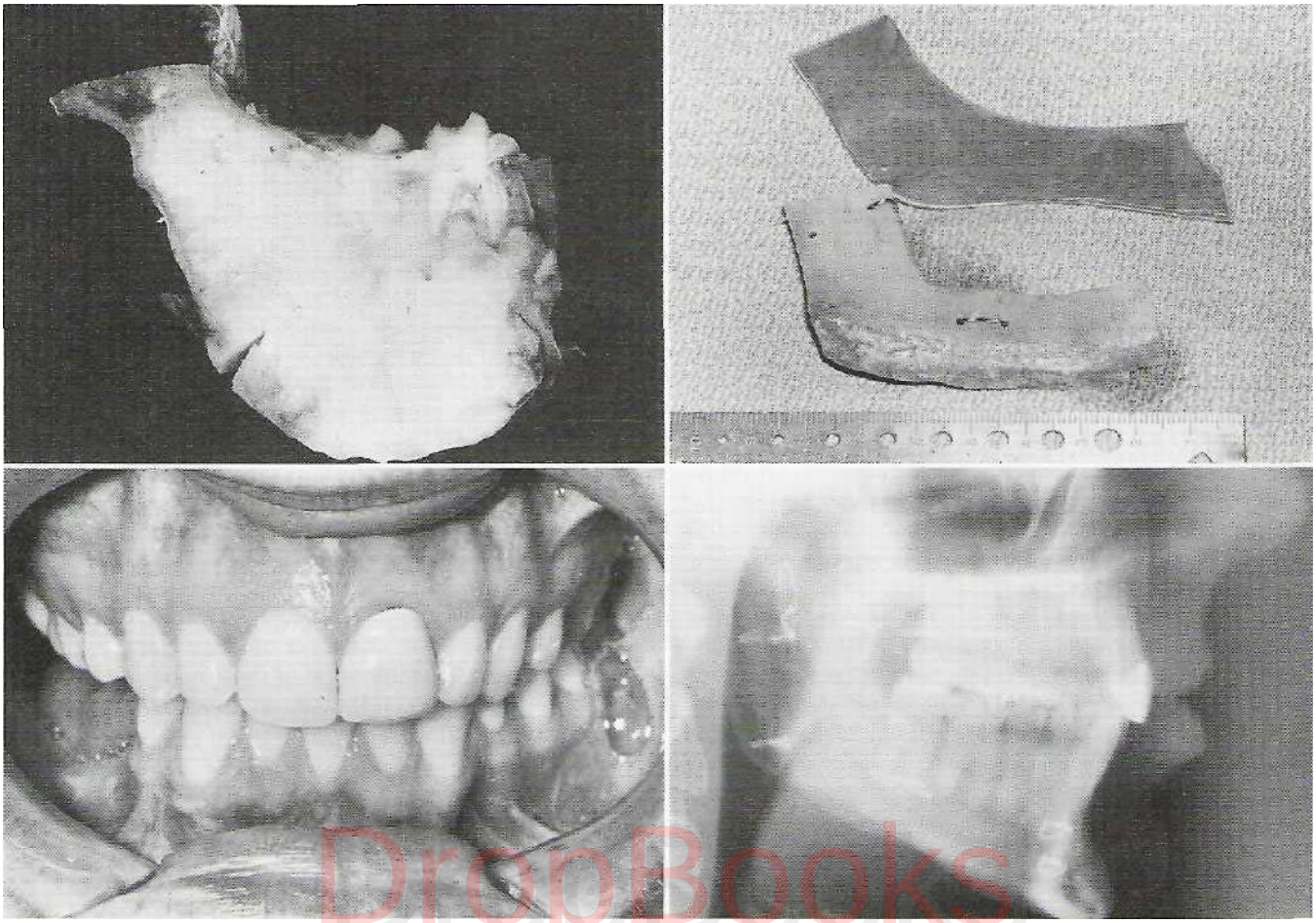

FIG. 22-10—cont'd C, Lesion after sectioning. D, Template same size as removed specimen used to harvest similarly sized and shaped bone graft. E, Intraoral appearance of patient 1 year postopera-

patient. In general, if a lesion can be completely excised without mutilating the patient, this is the preferred modality. If spread to regional lymph nodes is suspected, radiation may be used before or after surgery to help eliminate small foci of malignant cells in the adjacent areas. If widespread systemic metastasis is detected or if a tumor, such as a lymphoma, is especially chemosensitive, chemotherapy is used with or without surgery and radiation.

Currently malignancies are often treated in an institution where several specialists evaluate each case and discuss treatment regimens. These "tumor boards" include at least a surgeon, a chemotherapist, and a radiotherapist. Most head and neck tumor boards also include a general dentist, a maxillofacial prosthodontist, a nutritionist, a speech pathologist, and a sociologist or psychiatrist.

Radiotherapy. Radiotherapy for treatment of malignant neoplasms is based on the fact that tumor cells in stages of active growth are more susceptible to ionizing radiation than adult tissue. The faster the cells are multiplying or the more undifferentiated the tumor cells, the more likely that radiation is to be effective. Radiation prevents the cells from multiplying by interfering with their nuclear material. Normal host cells are also affected by radiation and must be protected as much as possible during treatment.

Radiation can be delivered to the patient in several forms, including implantation of radioactive material into the tumor. Most commonly, however, radiation is delivered externally by the use of large x-ray generators. The amount of radiation that a person may normally tolerate is not exceeded, and adjacent uninvolved areas are spared by the use of protective shielding. Two mechanisms of delivery, fractionation and multiple ports, spare the patient's host tissues in the immediate area of the tumor.

Fractionation of the delivery of radiation means that instead of giving the maximal amount of radiation a person can withstand at one time, smaller increments of radiation (i.e., fractions) are given over several weeks, which allows the healthier normal tissues time to recover between doses. The tumor cells, however, are less able to recover between doses. The other delivery method uses *multiple ports* for radiation exposure. Instead of delivering the entire dose through one beam (i.e., port), multiple beams are used. All beams are focused on the tumor but from different angles. Thus the tumor is exposed to the entire dose of radiation. However, because different beams are used, the normal tissues in the path of the x-ray beams are spared maximal exposure and instead receive only a fraction of the tumor dose.

Chemotherapy. Chemicals that act by interfering with rapidly growing tumor cells are used for treating many types of malignancies. As with radiation the chemicals are not totally selective but affect normal cells to some extent. Most of these agents are given intravenously; however, recently injections into the arteries feeding the tumor have been used. Because the agents are delivered systemically, they adversely affect many body systems; most notable is the hematopoietic system, which is considerably affected because of its rapid rate of cellular turnover. Thus patients who are undergoing chemotherapy are in a delicate balance between effectiveness in killing the tumor cells and anemia, neutropenia, and thrombocytopenia (see Chapter 18). Infections and bleeding are therefore common complications in these patients.

To reduce the toxicity of a single agent given in large quantities, multiple-agent therapy is frequently administered. Many patients are given three to five agents at the same time. Each may work at a different point in the life cycle of the tumor cell, thus increasing effectiveness with less toxicity to the host.

Surgery. The surgical procedures for excision of oral malignancies vary with the type and extent of the lesion. Small epidermoid carcinomas that are in accessible locations (e.g., the lower lip) and are not associated with palpable lymph nodes can be excised (Fig. 22-11). A larger lesion associated with palpable lymph nodes or a similar lesion in the area of the tonsillar pillar may require extensive surgery to adequately remove it and its local metastases.

Malignancies of the oral cavity that have either suspected or proven lymph node involvement are candidates for composite resection in which the lesion, surrounding tissues, and lymph nodes of the neck are totally removed. This procedure may produce large defects of the jaws and extensive loss of soft tissues, which make functional and esthetic rehabilitation a long, involved process.

SURGICAL MANAGEMENT OF BENIGN LESIONS IN ORAL SOFT TISSUES

Superficial soft tissue lesions of the oral mucosa are usually benign and in most instances lend themselves to simple surgical removal using biopsy techniques (see Chapter 21). They include fibromas, pyogenic granulomas, papillomas, peripheral giant cell granulomas, verruca vul-garis, mucoceles (i.e., mucous extravasation phenomena), and epulis fissuratum. All of these lesions are overgrowths of the normally present histologic elements in the oral mucosa and submucosa. The principles of removal are the same as those outlined previously and include the use of elliptic, wedge type of incisions during removal. In the case of lesions that appear associated with the dentition (i.e., pyogenic granuloma), the associated tooth or teeth should be thoroughly curetted and polished to remove any plaque, calculus, or foreign material that may have played a role in the lesion's development and that may cause a recurrence if not removed.

RECONSTRUCTION OF JAWS AFTER REMOVAL OF ORAL TUMORS

Osseous defects may occur after removal of oral tumors. These defects may range from loss of alveolar bone to loss of major portions of the jaw and may cause the patient concern on a functional or cosmetic basis. The treatment of oral pathologic entities should always include immediate or future plans for reconstruction that have been made *before* the surgical procedure to remove the lesion, to afford the patient optimal reconstructive results.

The general dentist plays a crucial role in the functional and cosmetic rehabilitation of the patient by providing dental replacements for teeth that have been surgically removed. However, before dental rehabilitation is pursued, the underlying skeleton of the jaws should be reconstructed, if necessary. Frequently, surgical removal of a lesion involves removal of a portion of the alveolus, which presents the dentist with an obvious problem: Any bridge across the site or any complete or partial denture will have no osseous base on which to rest. In these cases the patient would be well served to undergo ridge augmentation before dental restorative treatment. This augmentation can be in the form of bone grafts, synthetic bone grafts, or a combination of these materials. Optimal dental restorations can then be completed.

When the patient has lost a portion of the maxilla, the maxillary sinuses or nasal cavity may be continuous with the oral cavity, which presents great difficulties for the patient in speaking and eating. Defects of the maxilla can be managed in one of two ways: The first is with surgery. Defects that are not excessive may be closed with available soft tissues of the buccal mucosa and palate. Bone grafts may also be used to provide the patient with a functional alveolar process. Very large defects or defects in patients who are poor surgical risks may require prosthetic obliteration in which a partial or complete denture extends into the maxillary sinus or nasal cavities and effectively partitions the mouth from these structures (Fig. 22-12).

The reconstruction of a defect caused by resection of the mandible or a portion thereof can be performed immediately (i.e., at the time of the surgical removal of the lesion) or may be delayed until a later date. In general, benign processes of the jaws are reconstructed immediately, whereas malignancies are reconstructed later. Reconstruction after the surgical removal of a malignancy is performed for several reasons. Radiation is frequently used adjunctively with surgery and may jeopardize the survival of bone grafts. Another reason for delay is that soft tissue deficits may result after removal of the malignancy, and additional soft tissues may be required before osseous reconstruction can be performed. A very important reason, however, is that recurrence of the malignancy may require further extirpative surgery that will negate the reconstructive efforts.

Several surgeons also delay reconstruction of defect caused by removal of benign tumors. They suggest that the presence of a simultaneous intraoral and extract defect, which frequently is necessary to remove the

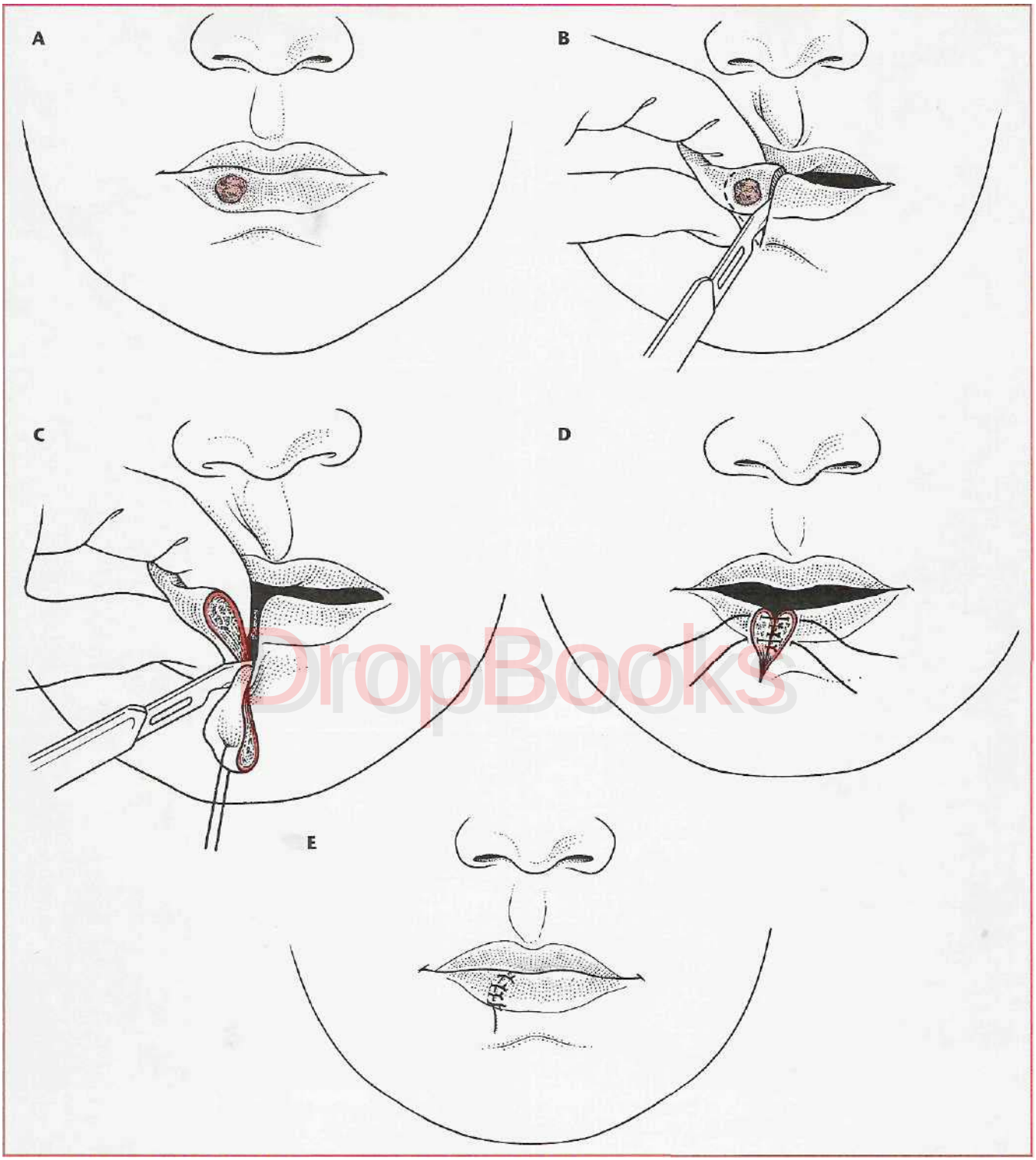

FIG. 22-11 Local excision of lip carcinoma. A to E, Full-thickness V excision of lip.

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tumor, contraindicates an immediate reconstruction of the mandible. Instead, a space-maintaining device is placed at the time of resection, and a secondary reconstruction is performed weeks to months later.[6-7]

When delayed reconstruction is decided upon, consideration should be given to maintaining the residual mandibular fragments in their normal anatomic relationship with intermaxillary fixation, external pin fixation,

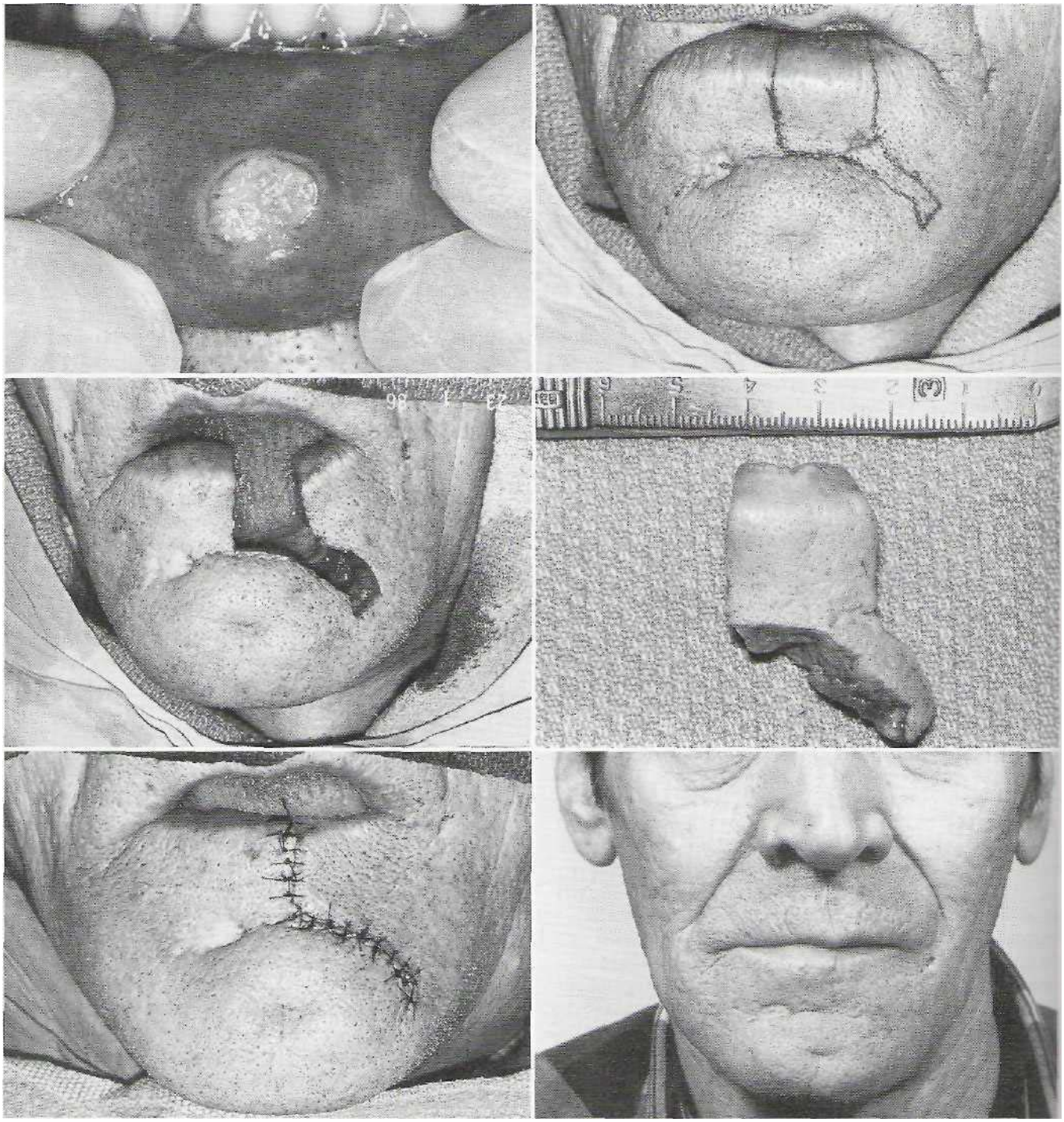

FIG. 22-11-cont'd **F**, Carcinoma of lower lip. **G**, Surgical incisions outlined. **H,** Lip after excision of specimen**. I**, Specimen**. J**, Closure**. K**, Appearance after healing.

splints, internal fixation, or a combination of these modalities. This technique prevents ricatricial and muscular deformation and displacement of the segments and simplifies secondary reconstructive efforts.

Clinical results have shown that immediate reconstruction is a viable option and has the advantages of requiring a single surgical procedure and having an early return to function with a minimal compromise to facial esthetics.[6] A possible disadvantage is loss of the graft from infection. The risk of infection may be higher when a graft is placed transorally or in an extraoral wound th.at was orally contaminated during the extirpative surgery Because the recurrence rate is substantial in some tumors, prudent planning and meticulous surgery are mandatory before reconstruction is attempted. These measures minimize the risk of failure as a result of recurrence. Three choices for immediate reconstruction are possible.

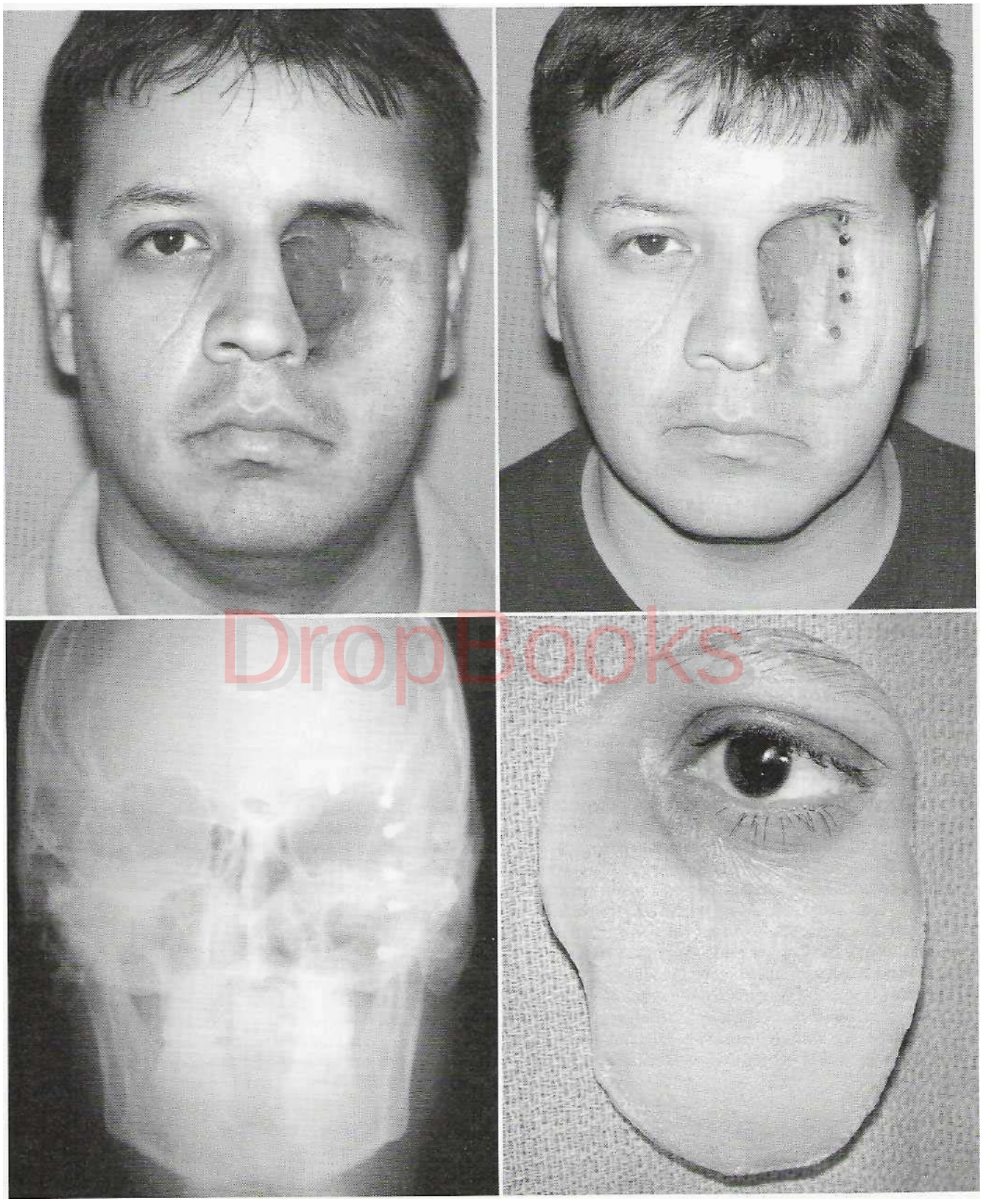

FIG. 22-12 Maxillofacial prosthetic reconstruction of patient who had left eye and palate removed because of tumor. A, Photograph shows defect

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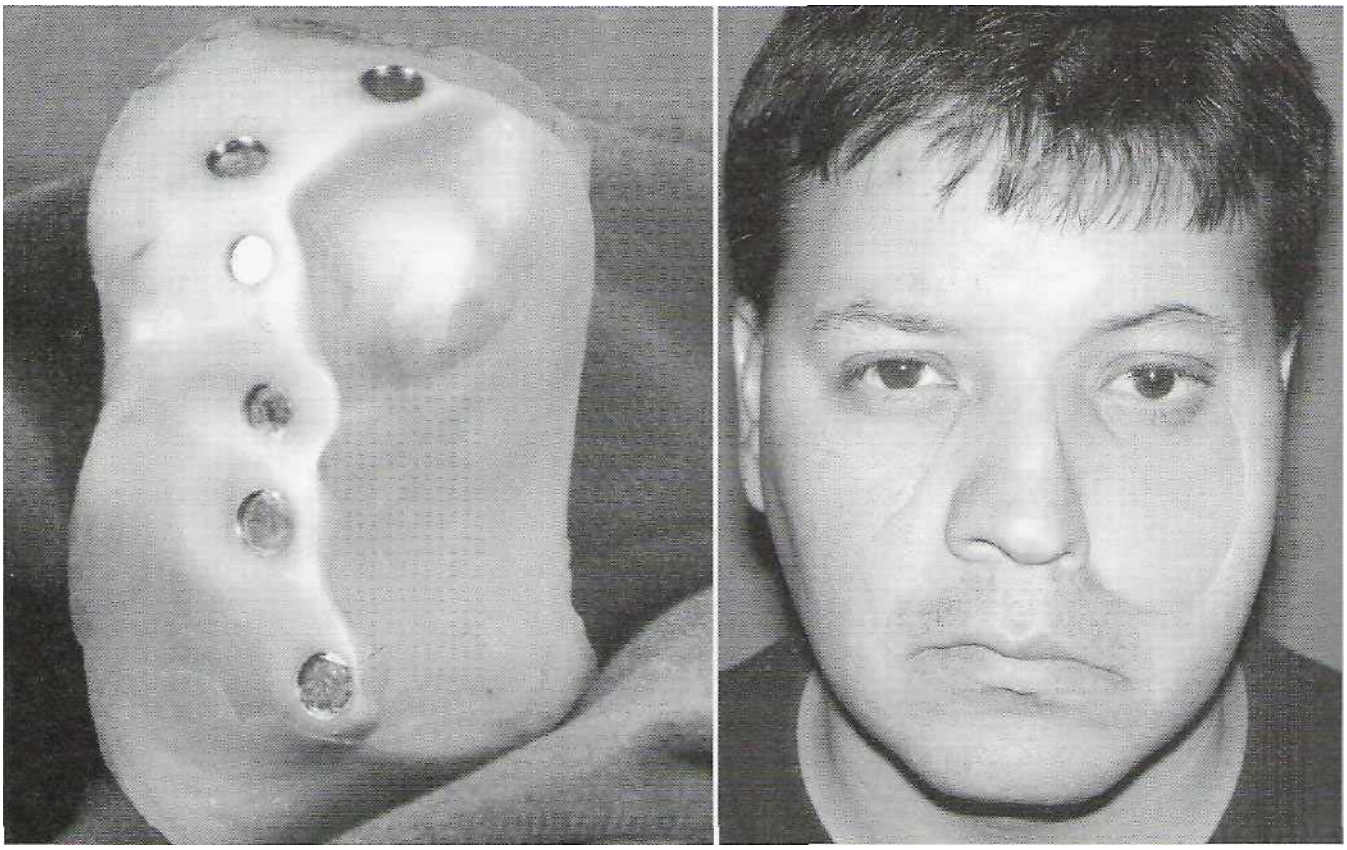

FIG. 22-12—cont'd **E,** Prosthetic denture. **F**, Patient with prosthetic eye and denture in place.

1. The entire surgical procedure is performed intraorally by first removing the tumor and then grafting the defect.
2. The tumor is removed by a combined intraoral and extraoral route. A watertight oral closure is obtained, which is followed immediately by grafting the defect through the extraoral incision.
3. When the tumor has not destroyed the alveolar crestal bone and when no extension of the tumor into oral soft tissues has occurred, the involved teeth are extracted. A waiting period of 6 to 8 weeks is allowed for healing of the gingival tissues. The tumor is then removed and the defect grafted through an extraoral incision, with care taken to avoid perforation of the oral soft tissues. This procedure is the only type of *immediate* reconstruction with which oral contamination can be avoided.

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